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CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE."

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME XXXV.—1877.

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THE CHEMICAL NEWS.

VOLUME XXXV.

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No. 893.—JANUARY 5, 1877.

ON THE

ESTIMATION OF PHOSPHORUS IN THE FORM OF PHOSPHO-AMMONIO-MOLYBDIC SALT, $(5H_4NO,2P_2O_5)+(5H_2O,10MoO_3)$.

By SERGIUS KERN, St. Petersburg.

EGGERTZ gives in his Swedish work, "Om Kemisk, profning af Tern, Ternmalmer, och Braennmaterialier," a method of quantitative analysis of phosphorus which is based on the precipitation of phosphorus in the form of phospho-ammonio-molybdic salt by a mixture called "molybdic solution," prepared by dissolving 100 grms. of molybdic acid in 422 c.c. of ammonia, 0·95 specific gravity, and mixing this solution with 1250 c.c. of nitric acid, 1·20 specific gravity. This method he employed in analyses of iron and steel, and since then a great many analyses have been executed by this method in laboratories of iron works. Working now almost entirely with products of such works, and analysing Bessemer and crucible steels for phosphorus, I find that the method as designed by Eggertz must be altered in details. The author of this method advises to proceed as follows for the quantitative analysis of phosphorus:—

1 grm. of the iron specimen is dissolved in 12 c.c. of nitric acid; the liquor is next evaporated on a sand-bath to dryness; the residue is dissolved in 5 c.c. of aqua regia, and to the solution 4 c.c. of water is added. The liquor is filtered from the silica; the filtrate must not be more than 20 c.c. From this solution the phosphorus is precipitated by about 30 c.c. of molybdic liquor, the preparation of which has been already mentioned. The solution is left for 15 hours in a warm place, and is then filtered. The precipitate containing phosphorus is washed by cold water acidulated with one per cent. of nitric acid. The yellow precipitate is dried on the filter at 100° in an air-bath and weighed. This precipitate contains 1·63 per cent. of phosphorus. On this process I wish to make some remarks—practical remarks, I had better say.

1. For dissolving iron it is better to use aqua regia, because nitric acid is not such a powerful agent for decomposing the whole of the organic matter which is often found in irons; the presence of this was found to prevent the precipitation of phosphorus by the molybdic solution.

2. The process of filtration and washing of the yellow precipitate must be executed very rapidly, because otherwise a certain quantity of the yellow precipitate is dissolved, and passes through the filter with the solution. Many trials were made, and it was always found that a small quantity of the precipitate passed into solution. In this case a lower percentage of phosphorus is obtained; this gives incorrect results in analysing steels and irons, and such materials where a small amount of phosphorus not estimated may give faulty results in the classification of the materials.

3. Eggertz advises to wash the yellow precipitate with water acidulated by nitric acid, and dry it on the filter at 100°. In practice this operation is nearly impossible, firstly because the precipitate is slightly soluble in acidulated water, secondly because a small quantity of the acid always remains on the filter, from which the filter when dried is always a little rotten; this fact also influences the percentage of phosphorus calculated.

The best method was found to be the following:—

1 grm. of the specimen is dissolved in 20 c.c. of aqua regia, and the phosphorus is precipitated by Eggertz's method; the resulting yellow precipitate, separated from the solution, is dissolved on the filter in ammonia, and in the filtrate obtained, slightly acidulated by hydrochloric acid, the phosphorus is precipitated in the form of phospho-ammonio magnesic salt $[Mg(NH_4)PO_4]$ by "magnesium mixture," prepared by dissolving 1 grm. of $MgSO_4$ and 1 grm. of NH_4Cl in 8 c.c. of water mixed with 4 c.c. of ammonia. The precipitation is finished in 15 to 20 hours; the precipitate is filtered from the solution, washed with water containing half a per cent. of ammonia, and first gently heated in a platinum crucible till free NH_3 and H_2O are evaporated; the crucible next is ignited for 30 to 40 minutes, and the received $Mg_2P_2O_7$ is weighed. This salt contains 13·51 per cent. of phosphorus.

This combination of Eggertz's method with the old one gives very exact results in analyses of irons and steels.

Obouchoff Steel Works, St. Petersburg.

NEW APPLICATIONS OF GLYCERIN IN THE LABORATORY.

By A. H. CHURCH, M.A.

FOR some time past I have used glycerin for preventing the adhesion of vulcanised india-rubber tubing to the inlet pipes of Bunsen and other gas-burners. A drop or two smeared on the parts in contact prevents both surfaces from suffering those changes which give rise to such continued annoyance in the laboratory. The glycerin should be pure.

One of the most serious drawbacks to the use of paraffin lamps for microscopic and other purposes is the perpetual creeping out of some of the hydrocarbon through the cement wherewith the metal burner is fixed to the glass reservoir. If this cement be soaked with glycerin before oil of any kind be introduced into the lamp this annoyance does not occur.

ON THE SPECTRA OF LIGHTNING.

By J. W. CLARK.

Another opportunity of observing the spectrum of forked lightning having occurred, the following observations were made:—Out of 26 observations, 11 spectra showed bright lines of oxygen, nitrogen (at times apparently also of hydrogen), 7 more were uncertain on account of their being too faint, and the remaining 8 were continuous, but without lines. A few more spectra resembled those previously described (Chemical News, vols. xxx. and xxxii.), in which *parts* of the spectra were alone visible, particularly the red end, but sometimes the space between the solar lines D and F or D and E was seen of a uniform and almost white colour (Chemical News, vol. xxxii.), which now seemed to be possibly due either to the flash not being sufficiently bright or to its not being in the direction of the axis of the spectroscope. Previously, however, the same appearance was observed with very bright flashes. The density of the air in which the discharge takes place will probably influence the nature of the spectrum, and the amount of aqueous vapour may also affect it, as determining the amount of incandescent hydrogen, which, as is well known, shows remarkable changes in its spectrum when subjected to varying pressure and temperature.*

* See Wüllner, "Lehrbuch der Physik," Bd. II., s. 244, and Schellen "Spectralanalyse," s. 167.

THE ANALYSIS OF SOAP.

Weighing.—In all methods usually given in text-books the analyst is directed to weigh out for each operation small portions (1 to 5 grm.) of the sample. This plan is to be avoided, and for two reasons:—(1) Soap is extremely variable in composition, and considerable variations are possible even in the same sample; (2) It is perpetually losing water by evaporation from its surface. As the soap is usually weighed in the form of thin shavings, the surface exposed is, in relation to the weight taken, very considerable. These two sources of inaccuracy are obviated by weighing out for the analysis a section cut through the bar at right angles to its length (60 to 80 grms.), dissolving in distilled water, and making the volume up to 1000 c.c. (in the cold); 50 c.c. of this solution are measured off for each operation. It should be observed that as some of the alkaline salts of the fatty acids separate out from the solution on cooling it must be well mixed, by agitation, previously to drawing off each 50 c.c. The several operations are conducted as follows:—

I. *Total Alkali.*—50 c.c. of the solution are diluted to about 200 c.c., the liquid is coloured faintly with eosine, and standard acid is run in, taking care to stir briskly with a glass rod. The neutral point is extremely well marked by the sudden decolorisation of the whole. The cause of this apparent destruction of colour is the union of the fatty acids with the eosine at the moment of their complete separation from the fluid.

II. *Uncombined Alkali.*—50 c.c. are added to 300 c.c. of a saturated solution of common salt, which must be, of course, neutral to test paper, and the volume made up to 400 c.c. The neutral alkaline salts of the fatty acids (*i.e.*, true soap) are precipitated; any excess of alkali present remains in solution; this is determined in an aliquot part of the filtered solution; the filter must not be moistened previous to filtration; from this the total uncombined alkali is calculated, and subtracted from the *total alkali* already found. Then the *combined* and *uncombined* alkali are determined.

III. *Fatty Acids.*—50 c.c. of this solution are introduced into a stoppered separating funnel, decomposed with excess of acid and agitated with carbon disulphide until the liberated fatty acids are dissolved. The disulphide solution of the fats is drawn off into a tared flask; the aqueous solution is washed once or twice with small portions of disulphide, the whole of which is then separated from the fats by distillation. The fats are purified from the last traces of CS_2 by heating the flask for a short time at 100° C.; the weight, after cooling, less the tare, gives the weight of the fatty acids. Ordinary ether may be used in place of the CS_2; it has, however, the disadvantage of retaining small quantities of water, and, therefore, aqueous acids, which must be driven off at the end of the operation by exposing to a temperature of 100 to 120° C., until the weight is constant. Further, the ethereal solution will be the upper stratum, and is, for obvious reasons, not so easily to be manipulated as the bisulphide solution, which forms the lower layer.

Note.—A moment's consideration of the following equation representing the decomposition of sodic oleate by HCl:—

$$2\left\{\begin{matrix}C_{18}H_{33}O\\Na\end{matrix}\right\}O + 2HCl = 2NaCl + 2\left\{\begin{matrix}C_{18}H_{33}O\\H\end{matrix}\right\}O.$$

will make it evident that while the fatty acid is present in the soap in the form of anhydride, it is separated and weighed in the course of analysis as hydrate. A correction must, therefore, be applied based upon the fact that 282 parts oleic hydrate = 273 parts oleic anhydride—*i.e.*, the weight of the fatty acids is to be multiplied by the decimal fraction 0·97.

In the case of the "Olein" soaps of commerce a very rapid and tolerably accurate estimation may be made in the following way:—50 c.c. of the solution are decomposed with HCl in a small flask, the neck of which is long and narrow, and graduated in c.c., and so much water added that, upon heating in the water-bath, the separated oil will rise into the neck and fall entirely within the graduated portion. The heating must be continued, with occasional tapping of the flask, until the whole of the fat has been separated and has risen into the neck. The flask is allowed to cool, and when cool the volume of the oil is read off. This quantity, multiplied by the specific gravity of the oil, gives its weight. The specific gravity (which I have almost always found to be 0·9) may be determined by pouring off a small quantity into a capsule; (a second reading will give the volume taken), and weighing it; the weight divided by the volume is the required specific gravity.

IV. *Water.*—If the purity of the sample has been ascertained this constituent may be calculated by difference. The direct estimation is effected by evaporating 50 c.c. of the solution to dryness on the water-bath (finally in the air-bath from 100° to 120° c.) in a weighed dish. The residue is anhydrous soap; from its weight the percentage of water in the soap may readily be calculated. It may be observed that the usual method, which consists in the exposure of the soap, previously cut into thin shavings and weighed, to the temperature of boiling water until it ceases to lose weight, is inaccurate, as it fails to drive off the last portions of water (1 to 2 per cent), which seem to have contracted a stronger union with the soap.

V. *Mineral impurities and unsaponified fat* may be detected by taking the dried soap from the preceding operation, dissolving in strong alcohol, and filtering through a funnel heated by means of a jacket of hot water. *Mineral impurities* remain upon the filter as an insoluble residue, the weight of which is readily ascertained. The alcoholic filtrate is evaporated with successive additions of distilled water; by these means any unsaponified fat or resin is separated from the soap, which, of course, remains in aqueous solution. This solution may be used for I., II., or III. The mineral impurities may be examined qualitatively after drying and weighing.

C. F. C.

The Laboratory, Owens College,
December 15, 1876.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from, vol. xxxiii., p. 245.)

The Sulphur Industry of Sicily.
By Dr. Angelo Barbaglia.

The Work in the Sulphur Mines.—The miners who raise the sulphur ores are called *picconieri*, and work under the direction of foremen known as *capo mastri*. At the head of the establishment, immediately under the proprietory, there is now generally a scientifically-trained mining engineer. The duty of the picconieri is to split out the sulphur ore from the veins, and to break it up, which is done with heavy hammers (*piccone*), weighing about 6 kilos., and sharpened on one side to facilitate the splitting. Gunpowder is very rarely used except where the gangue consists of the hardest limestone. The adits follow the direction and inclination of the veins, and branch out at places where the ore is rich and easy to work. In this manner are formed a series of spaces known as *gallerie* or *caverne* of every form and size opening into each other in the most various manner. The breadth of these galleries varies from 2 to 2½ metres; their height fluctuates and depends to a certain extent on the thickness of the beds, and especially on the hardness of the rock enclosing the sulphur ores. Where this rock is soft it would be dangerous to give the galleries a greater height than 2 metres, and to prevent accidents the sides are often supported by walls either run up dry or cemented with gypsum.

The 14 to 15 million quintals of ore furnished yearly by the 250 solfares of Sicily are almost exclusively transported by human labour. Both in the galleries and up to the mouth of the pit the mineral is carried by thousands of boys of from eight to ten years old (*manuali*), who convey the ore on their backs or shoulders. Only when the mine attains a depth exceeding 100 metres this method of transportation is abandoned both in accordance with the sanitary laws and from economic considerations. At such depths, and especially when water has to be removed, machinery must be brought into play or the mine abandoned. In such cases horse-galleries (*gallerie di carreggiatura*) have long been employed in Sicily, but if water has to be lifted vertical shafts (*pozzi verticali*) become necessary.

Hitherto horse or cart galleries have only been introduced in four solfares, those of Montagna Vecchia (Province of Aragona), San Giovanello, and Montelonge (Province Caltelltermini), and Galleria Ercole (Province Sommatino). According to statistical returns collected in 1865 this system has shown very favourable results.

The first attempts at raising the ore by means of shafts were made at a solfare in the district of Respica (Province Villarosa), and in another on the Colle di Madore (Province of Lercara), by a French mining engineer named De Labretoigne. They were carried on intermittently from 1859 to 1861, but the result was so unsatisfactory that they were given up. In 1865 similar experiments were made at the Solfare of Montedore, but with no better issue; and not until 1868 was the use of shafts seriously taken in hand and successfully carried out. This took place at the Solfare of Grottacalda, at that time under the management of the mining engineer Parodi, from whose report we take this brief extract. Here the shafts proved so advantageous that the same system was soon introduced in the solfares of Floristella, of Gallizzi, and in others of less importance. The new arrangement at Grottacalda cost 78,000 lire; the shaft is 137 metres in depth, and has been in use for raising the ore since 1871.

Since 1872 a steam-engine of 40 horse-power has been working in the great solfara of Sommatino. At the same time shafts were commenced at the solfaras of Raddassa, Montagna (Province Sommatino), and Trabonella in the neighbourhood of Sanatra (Province of Caltanisetta), exclusively destined, however, for the removal of water. In place of the wooden pumps formerly in use metal pumps have been already introduced, which are managed by workmen named *trombatori*.

If we compare the returns of the year 1867 with those of 1871 very notable progress will be perceived. Whilst at the end of 1867, 13 solfaras only employed 20 steam engines, with a collective power of 256 horses, in 1872 21 solfaras are working with 400 horse-power. In the construction of the engines, which are now built on scientific principles, great improvements have been made.

At the mouth of the sulphur mine, each picconiero with the help of his manuali, throws the ore he has raised into a heap (*catasta*), which is then measured by specially appointed officials (*catastieri dell' amministrazione*). As a unity of measurement the *cassa* is employed, a vessel of the form of a parallelepidon which, in different mines holds from 2·5 to 5 cubic metres.

The extraction of the sulphur in Sicily is almost exclusively effected by fusion. The eliquefaction in small cast-iron apparatus (called *doppioni*, because they are fixed in pairs, retort and receiver) as is customary in some solfaras of the Romagna, or in earthen vessels (*pignatti di argilla*), as described in manuals of chemistry, has never been in use in Sicily. As far back as tradition extends very primitive arrangements have been in use in the island, known as *calcarelle*.

For this purpose round holes were dug in the ground of about 2·5 metres in diameter and 4 decimetres in depth, in in the midst of which the *picconieri* piled up the sulphur ores in a high mound—an operation which generally took up two days. This heap was set on fire in the evening, and in the morning of the next day so much liquid sulphur has collected in the outer part of the hole that it can be scooped out and cast into rolls—an operation which lasts till evening, and is resumed on the following day. This process involved little outlay, but the yield was small. Only one-third of the sulphur in the ores was utilized, the remaining two-thirds being diffused in the atmosphere as sulphurous acid, to the annoyance of the inhabitants, and to the serious injury of the adjacent fields.

Since 1850 the eliquation or sulphur in Sicily has been materially improved by the conversion of the *calcarelle* into *calcaroni*. The latter, as the word itself implies, are merely excavations liks those described above, but on a much larger scale, and of an improved construction. They are large round cavities of a semicular or semi-elliptical section, of about 10 metres in diameter and 2·5 metres in depth. They are generally contrived in places where the slope of the ground renders it practicable to arrange a communication from without with the lower part of the calcarone, the bottom of which is made inclining to this point. This external communication, curiously known as *la morte*, consists in an aperture 1·20 metre high and 25 centimetres broad. Within the *calcarone* is lined with a wall of gypsun, from 4 to 5 decimetres in thickness at the back, (*i.e.* the part fu chest from the opening), but from 1 to 1·2 metre at the front. The masonry is lined with a smooth layer of gypsum, impenetrable by melted sulphur.

The *calcarone* is charged by workmen known as *riempitori*. The cover, the bottom—which is either the mere ground, or, preferably, a hearth formed of hewn stone—first with a layer of finely ground burnt ore from former operations, (*ginese*) upon which follows a stratum of larger lumps of ore (*tozzi*). Upon this foundation the ore is heaped up, care being taken to put the smaller pieces principally on the outside of the heap. At the same time the outer communication is blocked up with a kind of vault, (*porte*) which is built up with large blocks of the

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

poorest ore about its internal aperture. As soon as the cavity is filled up to the margin the workmen pile up more ore, forming a mound of the shape of a blunted cone, (*colmatura, cucuzzo*) still keeping the larger blocks in the centre, and the smaller about the circumference. By means of the large blocks it is found practicable to leave vertical chimney-like openings in various places, not too far from the margin, and especially at the back of the *calcarone* in order to regulate the draught. The mound is then covered with a stratum of finest powdered ore, (*sterro*) over which follows lastly a coating of ground burnt ore (*ginese*) and known as the *shirt* of the heap (*camicia*). Before igniting the *calcarone* the outward aperture is closed with a thin wall of gypsum, in which small holes are left at various heights, and are closed during the combustion with balls of clay. The heap is kindled by means of bundles of straw dipped in sulphur and thrown into the draught flues. After about an hour all apertures are closed, and the mound is left to itself for eight or nine days. Then mingled vapours of water, sulphur and sulphurous acid begin to make their way through the outer coating of the heap, and around the flues their appears a slight sublimate of sulphur. At the same time the barrier of the outward aperture becomes hotter and hotter near the ground, and finally red hot. By opening one of the holes which had been stoppered with clay, it is possible to aseertain whether a sufficient quantity of melted sulphur—*olio* as the workman call it, has collected at the bottom of the furnace. Now begins the work of the sulphur-casters (*arditori*) ; with a pointed iron bar (*spiedo*) they perforate the lower part of the gypsum wall, and collect the melted sulphur in moistened moulds of poplar wood (*gavite*) of the shape of a blunted pyramid. In this manner blocks of from 50 to 60 kilos. (*balate*) are obtained, and are sent to market without furtehr preparation. The tapping and casting the sulphur are not everywhere conducted in the same manner. In some works the sulphur is allowed to collect till the end of the entire combustion, and run off at once, but generally the *calcarone* is tapped twice or thrice in the course of 24 hours, so as to remove the sulphur as it collects. The *calcarone* is emptied and prepared for a fresh charge of workman known as *scalcaratori*.

(To be continued.)

ON THE GROWTH OF THE ALKALI AND BLEACHING-POWDER MANUFACTURE OF THE GLASGOW DISTRICT.*

By JAMES MACTEAR.

It has been considered that a slight historical sketch of the rise of the alkali and bleaching-powder manufacture of Glasgow (which indeed was the birthplace of the latter article) would fitly take its place in a report upon the chemical industries of the district, on the occasion of the visit of the Association at this time.

In the search after the necessary data, so many curious facts and figures cropped up, that indulgence must be craved for the length of the communication, which, even as it is, far from exhausts the subject.

Part I.—SALT.

Intimately connected with the manufacture of alkali and bleaching-powder is that of common salt.

The heavy duty on this article at the end of last and beginning of this century retarded for many years the development of the alkali trade.

The following details regarding the salt manufacture are interesting.

In the year 1798 (previous to the rise of duty which came into effect in the summer of that year). the quantity of salt manufactured in Scotland was 350,000 bushels of 56 lbs. each, or 8750 tons, produced by 118 pans distributed as below :—

Division.	Situation.	Pans.
Aberdeen	Patsoy	1
,, ...	Peterhead	2
,, ...	Nigg	2
Ayr	Maryburgh	1
Alloa	Limekilns	1
,, ...	Craigflowers ..	4
,, ...	Torryburn	1
Anstruther	St. Phillips	7
Borrowstouness ..	Corly Hall	7
,, ...	Thistone	7
,, ...	Grangepans	5
,, ...	Inverkeithing ..	4
,, ...	St. David's	4
Irvine	Saltcoats	4
Kircaldy	Kircaldy	2
,, ...	Dysart	7
,, ...	Wemyss	7
,, ...	Methel	8
,, ...	Leven	3
Montrose	Montrose	2
,, ...	Usan	1
Prestonpans	Prestonpans	6
,, ...	Cockenzie	11
,, ...	Cuttle	2
,, ...	Westpans	6
,, ...	Penkie pans	8
,, ...	Duddingstone ..	4
Stranraer	Gladmock	1
		118

Produced annualy, 350,000 bushels at 56 lbs. each = 8750 tons.

From this it would appear that each pan produced annually about 75 tons, or say 1½ tons per week.

The price was 3s. 3d. per bushel or £6 10s. per ton, duty inclusive, the latter being 1s. 6d. per bushel or £3 per ton.

The additional duty now put on was 6s. 6d. per bushel or £13 per ton, making the cost amount to £19 10s. per ton.

The duty in Scotland was much less than in England, the figures being in the year 1805—Scotland, £12 per ton ; England, £30 per ton.

The following is a statement of the method and cost of manufacturing one ton of salt, dated September, 1806 :—

"At Mr. Cunningham's works at Saltcoats there are in operation 4 pans, each 18 ft. by 9 ft. by 1 ft. 9 in. ; each pan requires three men, or twelve in all.

"These men are paid at the rate of 1s. 1d. per cwt., exclusive of house and fire.

"They keep their fire-places in order without any allowance, repairing them with schistus or clay, got in the immediate neighbourhood. The schistus answers for brick, and they say much better. They are not allowed for the time lost in repairing their boilers.

"The pans are of malleable iron of nearly ⅜ in. thick, supported on malleable iron bars about 3 in. square, placed across under each row of clink nails, say about 15 in. apart.

"A pan, with frequent repairs, lasts about five years, and costs when new about £200.

"These pans yield five castings of salt per week, weighing 10 to 11 cwts. each, agreeable to the strength of the sea water.

"In order to produce these 10 to 11 cwts. of salt, the pan is filled three times till within four inches of the brim (they cannot be filled more with advantage to the ebullition).

"The two first fills are boiled down till the salt begins to form, the first down to within about one inch of the

* Read before the Chemical Section of the British Association, Glasgow Meeting, 1876.

bottom, the second to within about one and a half inches, and the last to about two and a quarter inches, which consists chiefly of the pretty dry salt.

"This salt is then raked to the side of the pan, and thrown into a square chest, where it is allowed to drain till a third easting is ready to replace it, two chests being always employed.

"While in this situation it yields about 20 gallons of bittern, or 'pan oil,' as the workmen call it.

"In each pan there are four small round vessels of 8 in. by 4 in., placed one in each corner, which, during the evaporation, collect all the insoluble salts and impurities deposited during the process, sometimes more or less, in proportion, it is said, to the weakness of the water.

"*State of Charges by the ton weight.*

Wages	£1 1 8
Coal dross, 162-192, say 180 cwts., at 1d.	0 15 0
Tear and wear, say..	0 10 0
Rent, say	0 4 0
Cartage of coals, at ½d. per cwt...	0 3 9
	£2 14 5"

The manufacture of salt is still continued at Saltcoats, but on a different system, the sea water being employed to dissolve rock-salt obtained from Ireland, which gives a solution requiring much less evaporation than the old system.

This method is also carried out to a small extent in Glasgow.

The following table gives the prices of salt for chemical purposes in Glasgow from the year 1798:—

Year.	Price per Ton.
1798	£13 to £18
1800	12 0 0
1801	No details.
1802	,,
1803	£12 0 0
1804	12 0 0
1809	19 0 0
1814	11 0 0
1819	1 12 0
1824	2 6 0
1829	1 2 0
1834	0 19 0
1839	1 1 0
1144	0 16 0
1849	0 17 0
1854	0 15 0
1859	0 16 0
1864	0 14 0
1869	0 14 6

At or about which price it has since remained.

The quality of salt used for chemical purposes previous to the introduction of the method of bleaching by chlorine, must of course have been small. Marine acid, however, was made, and there is a tradition amongst the oldest workmen of the chemical works that it was produced (some years previous to the introduction of sulphuric acid about 1749) by the distillation of salt and earthy matter. That this process was actually in use is extremely probable, as it is described by the writers of the last century—eight parts of clay or bolar earth to one of salt being the mixture recommended, distilled in stoneware retorts.

(To be continued).

Supporting Power of Horse-shoe Magnets.—M. V. S. M. van der Weiden.—Free magnetism in a closed and supersaturated magnet is less than for one open and permanent. Free magnetism in the latter state is to the magnetism in the open state about as 3 to 10, a proportion which becomes more and constant as the magnet approaches a definitive permanence.—*Comptes Rendus.*

ON THE DETECTION OF ROSOLIC ACID IN PRESENCE OF MAGENTA.

By MM. F. GUYOT AND R. BIDAUX.

Rosolic acid, which dissolves in water with the colour of onion peel, possesses the property of communicating to wines the characteristic shade of old claret. We think it useful to make known at the present time the reactions which serve to detect it, either alone, or in presence of magenta. Some time ago we remarked that magenta is decolourised in presence of ammonia, and that ether removes from the mixture the colouring base, which may be reconstituted by the addition of an acid. In these conditions rosolic acid yields a characteristic rose tint and gives up nothing to ether. If we pour an acid into the rosolic solution, the shade of old claret is destroyed and gives place to a yellowish tint. If heated with gun-cotton, the rosolic liquor is fixed on the nitrogenised fibre, which, well washed and dried, takes a beautiful rose tint in presence of ammonia. This reaction may present itself in the course of the manipulations of an expert instructed to examine wines adulterated with magenta, and therefore it is well to mention it, for, we must call attention to the fact it is the very opposite to what ought to be produced. We easily understand the embarrasment of the expert who, after having obtained gun-cotton or nitrogenised paper slightly coloured, expects to see the colour disappear on contact with ammonia, but perceives, on the contrary, a very vivid rose shade, which, instead of brightening under the influence of acetic acid, becomes yellow. Into a flask containing ammoniacal rosolic acid, we poured sulphuric ether and then strongly agitated the liquid. After the complete separation of the two layers, the ethereal liquid was decanted and poured into another bottle. It was then limpid and colourless; we added to it pure acetic acid, which produced no change; the two layers separated and remained perfectly white. There was therefore no colouration, which shows that, in presence of ammonia, the ether does not remove rosolic acid. The inverse reaction is significant; rosolic acid, having become yellow under the influence of an acid, was treated as above with ether; the upper yellowish layer having been decanted, was submitted to the action of ammonia, which took a rose colour. If, in a flask, we put magenta with acetic acid, the rose tint does not change; ether added to this flask is coloured a violet rose. When decanted and treated with ammonia, there are formed at first two distinct layers, the lower one white and the upper ethereal, containing magenta. An excess of ammonia destroys immediately the colouration, and gives two layers perfectly colourless. It is important to remark that, whilst with magenta the ammonia renders the colouring matter white, with rosolic acid, on the contrary, the same alkali developes a rose shade, *which floats on the colourless ether*. Here, it is the *aqueous liquid* which is coloured, whilst if we acidify ammoniacal ether containing magenta, it is the ether, if in sufficient quantity, which takes the characteristic rose tint. There are then, in these comparative experiments, two very distinct reactions, which can be made use of for the examination of liquids containing the two colouring matters. These reactions are shown in the table.

These reactions being well known, it is easy to separate from a single solution the two colouring matters. We pour into a flask the liquid so be examined; we add ammonia to it; we agitate with ether and then decant. In presence of acetic acid, the ether becomes coloured. This experiment can be checked by means of gun-cotton. In fact, if we saturate this nitrogenous matter with the decanted ether, it is changed into a gelatinous rose-coloured matter, with which we can obtain the reactions of magenta. As for the aqueous liquid, it may serve for a counter-test. The ammonia which it contains is driven off in the water-bath and and we add acetic acid, which communicates the yellow tint mentioned above. If treated then with ether

Gun-cotton	1. Ammonia	Decolouration .. .. Magenta.
		Red colouration .. .. Rosolic acid.
	2. Acetic acid	Red colouration .. .. Magenta.
		Decolouration .. .. Rosolic acid.
Ether and Ammoniacal Solution	1. Ammonia	No action with either of these colouring matters.
	2. Acetic acid	Red colouration .. .. Magenta.
		No action .. .. Rosolic acid.
Ether and Acetic Solution	1. Ammonia	Ether, at first of a rose colour, becomes decolourised Magenta.
		Red colouration of the upper layer .. .. Rosolic acid.
	2. Acetic acid	Ether coloured rose .. .. Magenta.
		No action .. .. Rosolic acid.

and ammonia, it is found in the desired conditions to furnish one of the reactions mentioned above. It remains for us to know if, on submitting the mixed liquid to the action of acetic acid and treating with ether, we can separate the two colouring matters. They are both removed by ether, poured into an acetic liquid, which contains then yellow rosolic acid and rose-coloured magenta. When separated from the aqueous liquid, this coloured ether furnishes a very distinct reaction. A few drops of of ammonia decolourise the ether and tinge the lower stratum rose-colour, magenta disappears, and rosolic acid passes into ammoniacal solution. This process, as may be seen, differs very slightly from the former. The original treatment with acetic acid has for its object to render soluble in ether the two colouring matters, and remove them from the water in a more concentrated form. It requires only two manipulations, which, in certain cases of rapid determination is very important—*Comptes Rendus.*

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 28, 1876.

Edward Schunck, Ph.D., F.R.S., Vice-President, in the Chair.

"*Note on a Manganese Ore from New South Wales, and on a Specimen of Native Silver from New Zealand,*" by M. M. Pattison Muir, F.R.S.E.

I lately received a small specimen of manganese ore taken from a very large deposit near Bathurst, N.S.W. The ore is said to constitute the greater part of a considerable mountain in that neighbourhood.

The sample was greyish black in colour; when broken it exhibited an ill-defined crystalline structure, and showed patches of dark brown or black intermingled with others of dark steel-grey colour.

When heated in a small glass tube a considerable quantity of water was evolved.

The amount of manganese dioxide was determined by the oxalic acid method of Fresenius and Will; the total quantity of manganese was also determined by precipitation with bromine water, after removal of ferric and aluminic oxides; the excess of manganese above that required for the formation of the amount of dioxide found to be present was calculated to protoxide.

The following are the results of the analysis:—

Manganese dioxide	78·72 per cent.
,, protoxide	3·66 ,,
Ferric and aluminic oxides	6·50 ,,
Silica	5·80 ,,
Moisture	4·75 ,,
	99·43

If the percentage amount of manganese dioxide be calculated on the dried specimen, it is found to amount to 82·21.

Traces of zinc and of sodium were also found.

The specimen of native silver, the analysis of which is appended, was sent to me from the Thames Goldfield, New Zealand. It presented the appearance of arborescent crystals radiating outwards from a central mass at acute angles. A very small quantity of crystalline quartz could be seen in the cavities of the mass.

The silver was estimated by precipitation as chloride; the copper, mercury, &c., were precipitated by means of sulphuretted hydrogen; the copper was separated by solution in nitric acid, and estimated in this solution by the colorimetric method depending upon the use of potassium ferrocyanide, described by Carnelley (*Proc. Manchester Lit. and Phil. Soc.*, 1875-76, p. 24). The iron was precipitated by means of ammonium sulphide, the precipitate was dissolved in dilute hydrochloric acid, and the quantity of iron estimated by Carnelley's colorimetric method (*Proc. Lit. and Phil. Soc.*, vol. v., p. 346).

The sulphide of mercury was dissolved in aqua regia, and an attempt was made to estimate the quantity of the metal by Hannay's volumetric method (*Chem. Soc. Journ.* [2], xi., 565). The quantity present was, however, too small to admit of estimation by this method.

The mercury was approximately estimated by comparing the depth of colour produced in the liquid on the addition of sulphuretted hydrogen water with that produced in an equal bulk of pure water to which a known volume of standardised mercuric chloride solution had been added. This method did not give very satisfactory results; it was found that the shades of colour in the two liquids were not exactly the same. For this reason the quantity of mercury stated below must be regarded as approximative only.

Silica and gangue	1·93
Silver	97·05
Mercury	0·28
	99·26
Copper	0·00005
Iron	0·00109

Very minute traces of bismuth were also detected.

Mr. Muir also exhibited a number of new salts of bismuth, including several chromates, oxybromides, ferrocyanides, &c., likewise specimens of terpenes, &c., from essential oil of sage.

Ordinary Meeting, December 12, 1876.

E. W. Binney, F.R.S., F.G.S, President, in the Chair.

Mr. Baxendell read the following letter from Mr. Joseph Sidebotham, F.R.A.S., dated Mentone, December 7, 1876:—

There is a little matter I wish you would call attention to at one of the meetings of the Lit. and Phil. Soc., in order that the remarks of the members upon it may be obtained, and if thought desirable, published in the *Proceedings*, so as to come before the public.

My attention has been for some time directed to the growing use of the aniline colours for tinting photographs. Now I find they are being *extensively* used in paintings and water-colour drawings, and the colours regularly sold for that purpose. Any one who knows the speedy alteration by light of nearly all of these colours will protest against their use, and a statement of this with the authority of some of our chemists would probably have the effect of causing them to be discontinued by all artists who care to think that their works should last more than a single year.

Professor C. Schorlemmer, F.R.S., exhibited the new colouring matters *fluorescein*, *soluble eosin*, and *insoluble eosin*, as well as samples of silk and wool dyed by them, and showed the characteristic properties of these bodies.

"*On a Mineral Water from Humphrey Head, near Grange-over-Sands, North Lancashire*," by Joseph Barnes and Harry Grimshaw, F.C.S.

The mineral spring of which the following analyses have been made issues from the western side of the low promontory of Humphrey Head, almost at the base of the cliffs, and near to the sea shore, but quite above the ordinary high-water mark. The base of the rocks of which the substratum of the head is composed is washed by the tide when high, though it is far away from the water at its ebb in the wide and flat Morecambe Bay, in which the Humphey Head forms the division between the Milnthorpe, or Lancaster Sands, and the Ulverston, or Leven Sands. The north and east sides of the head descend in a gentle slope to the sands, whereas the west and south sides present a rugged and perpendicular face of limestone rock.

As regards the geology of the Head; the strata of which it is composed, consist of mountain limestone, based upon the upper Silurian, which structure, we learned from Professor Dawkins, is common to a great portion of that district. Humphrey Head, therefore, seems to form a small outlying spur of the mountain system of the district, but it is completely separated by a strip of low-lying land from the nearest connected spur of the high lands of the neighbourhood, which is Kirk Head and contains the well-known cave in which such interesting antiquarian discoveries have been made. The whole of this neighbourhood is remarkable for the general absence of streams or springs of any description, owing doubtless to the very porous nature of its rock formations, which allow the water to percolate down to the sea-level instead of finding their way along the surface to any extent.

The mineral spring which issues as described near the base of the Humphey Head, was formerly and we suppose is still known by the name of the Holy Well. Two samples of its water have been taken, the first (*a*) on August 29th, 1875, and the second (*b*) on the 20th of the same month, 1876. The following data were obtained on analysis:—

Sample (*a*) had an almost imperceptible alkaline reaction.

1.) Specific gravity—bottle holds 25·031 grms. water.
" " " 25·176 " mineral water.
Specific Gravity—1·00579 at 15° C.

(2.) Ammonia—half a litre distilled by Wanklyn's process gave 0·47 grm. free ammonia and 0·03 of alluminoid ammonia, equal to 0·94 and 0·06 pts. per million respectively.

(3.) Chlorine—10 c.c. of the water required 33·1 c.c. standard nitrate of silver (1 c.c. = 1 m.grm. Cl).

(4.) Total solid matter—100 c.c. on evaporation gave 0·729 grm., which on analysis gave—

(5.) Silica—0·0006 grm.

(6.) $BaSO_4$—0·294 containing 0·1008 SO_3.

(7.) $CaCO_3$—0·1088 " 0·0608 CaO.

(8.) $Mg_2P_2O_7$—0·08 " 0·0288 MgO.

(9.) Traces of iron and alumina were found.

Sample (*b*) had a neutral reaction.

(1.) Total solid matter—as a mean of three determinations 100 c.c. gave 0·7352 grm.

(2.) Chlorine—as a mean of two determinations 5 c.c. took 16·65 c.c., standard $AgNO_3$.

(3.) Hardness—10 c.c. were made up to 250 c.c., and 70 c.c. gave 4·1° of hardness.

(4.) Iron and alumina—traces were found.

Sample (*a*).	Grs. per Gal.	Sample (*b*). Grs. per Gal.
Silica (SiO_2)	0·42	—
Sulphuric acid (SO_3)	70·50	—
Lime (CaO)	42·50	—
Magnesia (MgO)	4·80	—
Magnesium (Mg)	9·37	—
Chlorine (Cl)	231·70	233·10
Alkalis (K and Na)	150·92	—
Total solids	510·30	514·64
Hardness	—	102·50

A calculation of these results on the usual assumptions of the combination of the different bases and acids, yields the following result for sample (*a*), leaving the small amounts of silica and ammonia out of consideration.

	Grms. per Gal.
Silica	0·42
Calcium sulphate	103·21
Magnesium sulphate	14·68
Magnesium chloride	37·07
Sodium chloride	270·03
Potassium chloride	84·90
	510·31

The lime is placed as in combination with sulphuric acid, as forming the most insoluble compound with it, and that a considerable amount of the magnesium is combined with chlorine is evident from the fact, that an estimation of chlorine in the solid residue, after heating it for some time to 170° C. gave only 219·8 grs. of Cl per gallon, showing a loss of 11·9 grs. The relative amounts of potassium and sodium chlorides are calculated by difference, from the total alkali and chlorine.

Remarks on Results of Analysis.—The proportion between the free and alluminoid ammonia, in this water is very remarkable, the amount of the former being conspicuously large (0·94 pts. per mil.), whereas the latter is hardly more than detectable (0·06). The amounts of alkaline chlorides (354·93 grms. per gal.) is very large, mostly consisting as will be seen of chloride of sodium. We are of opinion that this is due to the upward absorption of a certain amount of sea water by the porous rocks through which the waters of the spring find their way; in fact, the whole contents of the water seem to be only such as might be naturally expected from the nature of the rock construction of the Humphrey Head and its proximity to the sea. It is stated in works referring to this district that this sping was at one time in high repute for the medical qualities of its water, more especially in the cure of various cutaneous disorders, but at the present time it is seldom visited except from curiosity, though a few of the country people around seem to have a lingering belief in its virtues.

For some of the figures in the above analyses we owe our thanks to Mr. Chaster, late a student of the Owens College.

Since the above was written, our attention has been directed to an analysis of the water of this spring, published in the year 1868 in the *Journal of the Chemical Society* (2nd Series, VI., 20), by T. E. Thorpe (now F.R.S.), in which the author gives more minute details of the constituents of the water, than we have done in this paper, but which in the main shows that the quality of the water remains very constant. The exception to this is in the

amount of potash, which in our case (calculated from the amounts of acid and base) is much larger than in Trooper [illegible]. We hope at a later date to perform other and more minute analyses of this spring, in order to see as far as possible whether this uniformity is still maintained.

ACADEMIE DES SCIENCES.

[illegible] presented, in a somewhat bulky article, a valuable addition to the literature of the tertiary alcohols and ketones. He records the results of [illegible] experiments upon the formation of aceton and trimethyl carbinol by the action of acetyl chloride on zinc methyl in varied proportions, giving the quantitative results. A new tertiary heptyl alcohol, $C_7H_{16}O$, was obtained by treatment of butyryl chloride, first with zinc methyl and subsequently with zinc ethyl. This new compound, *methyl-ethyl propyl carbinol*, is the first tertiary alcohol containing three different hydrocarbons united with the same carbon atom, and forms a colourless liquid with the odour of camphor. The corresponding hydrocarbon, C_7H_{16}, an oily liquid boiling at 90° to 95°, is obtained from the iodine compound. *Methyl-ethyl isopropyl carbinol* is obtained in the same manner from isobutyryl chloride, and yields a hydrocarbon boiling at 75° to 80°. A series of experiments on the action of zinc methyl and zinc ethyl with aceton show that it possesses invariably a dehydrating character, and is always accompanied by the formation of condensation products, especially of mesityl oxide. The author has also obtained three compounds analogous to mesityloxide from the action of zinc methyl upon acid chlorides: $C_8H_{14}O$, from propionyl chloride; $C_{10}H_{18}O$, from isobutyryl chloride; and $C_{12}H_{22}O$, from valeryl chloride. These are all colourless liquids, boiling at high temperatures, with strong aromatic odours, and do not yield corresponding hydrocarbons.

WIENER AKADEMIE DER WISSENSCHAFTEN.

K. [illegible], "*Action of Glycerin [illegible] at High Temperature.*" A mixture of 50 grms. of potato or wheat starch with 1 kilogramme of concentrated glycerin, exposed to a gradually rising temperature under continual stirring, exhibits the following changes:—The granules gradually swell, and at 130° a pasty mass is formed. The consistency then decreases continually, and at 160° to 170° the starch is completely dissolved, forming a yellow transparent solution. At 190° the starch is almost entirely changed into the so-called soluble modification, which is separated out from the cold solution by dilution with water and addition of alcohol. This modification is easily soluble in water, and retains this property as long as it is preserved in a moist condition with alcohol, but loses it by drying. The aqueous solution gives the usual colouration with iodine, and turns the plane of polarisation very strongly to the right. Lime water and baryta water cause precipitation from the aqueous solution.

F. Odstreil, "*Experiments on the Magnetic Action of Rotatory Conductors.*" From a large number of observations of the magnetic effects caused by a rotating sphere of zinc upon magnets in the vicinity, the author finds that considerable deviations are caused as long as the axis of the sphere does not lie in the direction of the terrestrial magnetism. The law regulating the distribution of magnetic force according to the inclination of the axis has been fully defined. As these induced currents in a rotatory sphere are due to terrestrial-magnetism, the opinion of the author is strengthened that the periodically recurring deviations of the needle are possibly due to solar and lunar magnetism.

L. Barth and C. Senhofer, "*Action of Fuming [illegible] Sulphuric Acid on Meta-Disulpho-benzoïc Acid.*" Equal volumes of fuming sulphuric acid and sulpho-benzoïc acid, heated in a retort, yield meta-disulpho-benzoïc acid, $C_6H_4.(SHO_3)_2$, which is easily obtained pure by the usual treatment with carbonate of lead and sulphuretted hydrogen. It crystallises easily, is exceedingly deliquescent, and forms crystalline salts. The potassium salt treated with potassium cyanide yields meta-dicyan-benzol (M. Pt. 160°), which by treatment with potassium hydrate is changed into isophthalic acid. Both para- and meta-disulpho-benzoïc acids yield resorcine by melting with potassium hydrate, another proof that this process is not always reliable in determining constitutional formulæ.

O. [illegible], "*Derivatives of Ellagic Acid.*" Ellagic [illegible] dissolved in hydrogen yields two bodies, one red and the other colourless. The latter has been examined, and receives the name ellagine. It is isomeric with anthracen, phenanthren, and tolone, $C_{14}H_{10}$, but does not yield a quinon and picrate, or form a fluorescent solution in benzol, as its isomers. Reduction with sodium amalgam gives likewise two bodies. The first, *rufo-hydro-ellagic acid*, $C_{14}H_8O_6$, melts at 300°, is easily oxidised, forms no salts, and gives with ferric chloride a wine-red colouration. The second, $C_{14}H_{10}O_7$, is identical with a derivative of gallic acid previously obtained by the author, and now receives the name of *glauco-hydro-ellagic acid.*

L. [illegible], "*Nitro-Derivatives of Anthraflavon.*" Anthraflavon added to 40 times its weight of nitric acid causes, upon heating, a violent reaction. On cooling, yellow crystals of tetra-nitro-anthraflavon, $C_{12}H_4(NO_2)_4O_4$, separate out. Chrysophanic acid is the only isomer of anthraflavon forming a corresponding body. This nitro compound forms an exceedingly sensitive test for the presence of ammonia, the slightest trace of the latter causing the appearance of an intense red colour. Three distinct compounds are formed with ammonia—

$$C_{12}H_2(NO_2)_4(NH_4)_2O_4, \quad C_{12}H_3(NO_2)_4(NH_4)_2O_4 + NH_3,$$
$$\text{and } C_{12}H_2(NO_2)_4(NH_4)_2O_4 + 2NH_3.$$

In the filtrate from the crystals of tetranitro anthraflavon a *trinitro-oxy-benzoïc* acid, $C_7H_3(NO_2)_3O_3$, was found, which was also obtained from the first body by boiling for a long time with nitric acid. It forms crystalline salts, and gives a red colouration with ferric chloride.

C. Senhofer, "*A New Derivative of Naphthalin.*" A solution of naphthalin in sulphuric acid mingled with phosphoric anhydride, and heated in a closed tube for several hours at 260°, yields naphthalin-tetrasulphonic acid, $C_{10}H_4(SO_3H)_4$, the most highly substituted sulphonic acid in this group. The reaction could be used to advantage in many other cases.

L. Barth, "*Tetra-methyl-oxy-ammonium ferrocyanide.*" This compound, $[FeCy_2+[(CH_3)_4NCy]_4+r3H_2O$, is easily obtained by neutralising an aqueous solution of tetramethyl-ammonium-hydrate with ferrocyanic acid. Yellow, hexagonal laminæ, decomposed at 140°.

L. Boltzmann, "*Heat Equilibrium of Gases under the Influence of External Forces.*" A lengthy physico-mathematical article, in which the author seeks to prove that his law of probabilities and that of Maxwell, with regard to the positions, rapidity of motion, and direction of motion of gaseous molecules, when restoring the condition of heat-equilibrium, is also applicable in the case of exposure to the action of external forces, as well as in their absence.

L. Boltzmann, "*Convection of Heat in Gases.*" The author finds that Maxwell's constants for the theoretical determination of the convection of heat in gases are far too high when compared with the results obtained from Stefan's careful observations. From theoretical considerations he assigns $\frac{1}{3}^{8}$ as the general constant for the various gases, representing the portion of the convection of heat due to the intramolecular movement. The results obtained with this constant coincide very closely with Stefan's observations.

L. Boltzmann, "*Integration of Partial Differential Equations of the First Order.*"

H. Weisel, "*On Cinchonine.*" The author has previously described four new acids obtained from cinchonine by oxidation with nitric acid. Among the products of the reaction he has also discovered a fifth body, exceedingly soluble in water, and entering into combination with both acids and bases $C_{19}H_{21}N_2O$. The oxidation products of cinchonidine are found to be exactly the same as those derived from its isomer cinchonine.

H. Durège, "*Double Tangents of Curves of the Fourth Order.*"

R. Maly, "*Action of Bromine on Bilirubin.*" Upon mixing together solutions of both of these bodies in chloroform, a brilliant blue colour appears, and upon the addition of water, a greenish blue powder, tri-bromo-bilirubin, $C_{32}H_{33}Br_3N_4O_6$, is precipated. The new compound has also been prepared synthetically, and the results incline the author to double the present formula for bilirubin. The alcoholic solution examined with the spectroscope allows only green and blue light to pass through; upon the addition of zinc chloride and ammonia, a narrow, dark, well-defined line is perceived at 105 to 111, that is between the sodium and lithium lines. Tri-bromo-bilirubin is insoluble in water, soluble in alcohol and other strong solvents, crystallises in small black prisms, is changed by reducing substances to hydro-bilirubin, and by alkalies to biliverdin.

J. Tollinger, "*Thermal Phenomena attending the solution of Ammonium-nitrate in Water, and their Application in Freezing Mixtures.*" A lengthy article, giving the results of an extensive series of experiments, with regard to the determination of—(1) The specific heat of the solutions; (2) the heat required for solution at various temperatures; (3) the influence of the water used; (4) the lowering of the freezing-point; (5) the solubility of the salt. The conclusions arrived at, are that this solution is especially valuable when the temperature at the commencement is above 0°, and that the greatest economy is obtained by using a solution of such a degree of concentration that it will be exactly saturated when the desired temperature is attained.

S. L. Schenck, "*The Green Colouring Principle of Bonellia Viridis.*" Gottlieb has shown that the chemical properties of this coloring matter coincide with those of chlorophyll. The author finds the absorption spectrum given by an alcoholic solution somewhat different from that afforded by chlorophyll under the same conditions. The substance after having been preserved for twenty-five years, gives a different absorption spectrum from that afforded by it when freshly prepared, and coincides with the spectrum of the latter upon the addition of an organic acid to the solution.

J. Oser and G. Flögl, "*A New Condensation Product from Gallic Acid.*" Oxidation of gallic acid yields a new acid, hydrorufi-gallic acid, $C_{14}H_{10}O_8$, which is tolerably insoluble in water, but in other solvents gives rise to a variety of colour reactions.

NOTICES OF BOOKS.

The Faraday Lecture for 1875. The Life-Work of Liebig in Experimental and Philosophic Chemistry, with allusions to his Influence on the Development of the Collateral Sciences and of the Useful Arts. A Discourse. By A. W. Hofmann, F.R.S., V.P.C.S. London: Macmillan and Co.

It would be a mere waste of time on our part were we to attempt an abstract of the magnificent eulogium paid by Dr. Hofmann to the memory of his great master. It speaks for itself and renders all comment superfluous. But there are ideas put forth in this volume which have a wider interest even than the fame of the two great men with whom the discourse is more especially connected. It is often asked how ought science to be taught and what manner of men should be the teachers? In this country, at the present day—and more, we fear, than in times bye-gone—the whole duty of the teacher is summed up in "preparing" pupils for examinations. Students "read" instead of working for degrees and honours. Universities are regarded not as places for original research, but for cram. Now to us it seems that the question, How is chemistry to be taught?—and for every science the essential principle is the same—may best be answered by another, "How did Liebig teach?" For in addition to all his other merits he was the great type of the science teacher. The answer is ably and most truthfully given by Dr. Hofmann:—We felt then, we feel still, and never while we live, shall we forget Liebig's marvellous influence over us; and if anything could be more astonishing than the amount of work he did with his own hands it was probably the mountain of chemical toil he got us to go through. I am sure that he loved us in return. Each word of his carried instruction, every intonation of his voice bespoke regard; his approval was a mark of honour, and of whatever else he might be proud, our greatest pride of all was in having him for our master It was our delight, too, to know that we helped him that whilst we received his lessons we were also performing his work. The aid he thus obtained he was too just ever to deny or underrate; nay, his generosity often attributed te a pupil the whole credit of a successful experiment suggested by himself on the basis of previous trials and discoveries of his own, and of his deductions therefrom. Of our young winnings in the noble ground of philosophical honour, more than half were free gifts to us from Liebig; and to his generous nature no triumphs of his own brought more sincere delight than that which he took in seeing his pupils' success, and in assisting while he watched their upward struggle."

We should recommend every science-teacher to ask himself seriously, how nearly he is approaching, or endeavouring to approach, to this ideal? Is he training up investigators and filling their minds with an ardent love of truth for its own sake? If not—if he is either unwilling or unable to tread, though at a great distance, in the footsteps of Liebig—let him doubt whether he is "the right man in the right place." Some teachers may perhaps plead that they are the victims of a bad system—that their pupils are expected not so much to "know" as to "pass"—and that their reputation and efficiency are measured by such passing. If so, let them join in with those who are waging war against this miserable system. The only examination for a man of science is to prove, *rebus gestis*, that he can work.

The oration has also its lessons for the student. Liebig, we are told, was "ever anxious to retain the safe guidance of experiment. A happy speculator himself, he never fails to curb the evolutions of his imagination by the bridle of sober observation. If he finds his speculation to be in contradiction with recognised facts, he endeavours to set these facts aside by new experiments, and failing to do so he drops the speculation." He never forgot the lesson which he received in his early career when an ingenious theory cost him the discovery of bromine. Speaking of himself in the third person, he says:—"I know a chemist who, while at Kreuznach, many years ago, undertook an investigation of the mother-liquor from the salt works. He found iodine in it; he observed, moreover, that the iodide of starch turned of a fiery yellow by standing over night. The phenomenon struck him; he procured a large quantity of the mother-liquor, saturated it with chlorine, and obtained by distillation a considerable amount of a liquid colouring starch yellow, and possessing the external properties of chloride of iodine, but differing in many of its reactions from the latter compound. He explained, however, every discrepancy most satisfactorily to himself; he contrived for himself a theory

on it *ter machte sich eine Theorie daraber*). Several months later he received the splendid paper of M. Balard, and on the very same day he was in a condition to publish a series of experiments on the behaviour of bromine with iron, platinum, and carbon, for Balard's bromine stood in his laboratory labelled *liquid chlorate of iodine*. Since that time he makes no more theories unless they are supported by unequivocal experiments, and I can positively assert that he has not fared badly by so doing."

But Liebig's career affords a further lesson, which lies, so to speak, in the same direction, and which, though not referred to in the book before us, should not be overlooked. Liebig tells us that in one part of his early life he was seduced into those metaphysical studies which were then so popular in his country. For a time this pursuit seemed to him alike pleasant and profitable. But he suddenly awoke as from a dream, and found that two precious years of his life had been wasted without any benefit to himself and to science. At a time when metaphysical learning is again raising its head, and seeking to escape from the accusations of unprogressiveness and sterility—when it is even alleged as a reproach against eminent men of science that they are ignorant of metaphysics—this confession coming from a source so unimpeachable is of the highest value, and may prevent many from being misled.

CORRESPONDENCE.

ANTHRACEN TEST.

To the Editor of the Chemical News.

Sir,—In reference to the new test for anthracen published in the Chemical News (vol. xxxiv., p. 273) I think it is but right to say that the test in question was worked out by me, in the spring of 1876, at the request of the Badische Anilin and Soda Fabrik, of Ludwigshafen, and that no one has been authorised to publish it, as for the present, for various reasons into which I need not enter, it has not been considered desirable to do so.—I am, &c.,

Frederick A. Manning.

BUTTER ANALYSIS.

To the Editor of the Chemical News.

Sir,—I wish to supplement with a few remarks my short paper upon Butter Analysis which appeared in the Chemical News of December 15.

Those who have not got a balance of the kind described can readily apply the specific gravity beads instead of it, at any rate as indicators of the purity or otherwise of the butter under examination. All that is necessary is a large beaker kept full of water boiling, and supported in it the tubes full of the fat to be examined.

Three beads, one of which would float just under the surface of pure butter fat, one just under the surface of a 50 per cent. mixture, and one under the surface of beef fat (all tested at boiling heat of water), would at once give an approximate idea of the amount of adulteration the sample in which they were tried. I then advise, as the best practical method of estimating fairly the percentage of adulteration, that after the gravity has been obtained, the fatty acid determination be made. I invariably follow out this method when dealing with a case which may result in prosecution. I must apologise for the apparently imperfect description of my little apparatus in the Chemical News of December 15, but it was intended that a cut of the whole should accompany it, which, however, was at the last moment unavoidably omitted.

C. Estcourt.

8, St. James's Square, Manchester.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 22, November 27, 1876.

Crystals of Magnetic Oxide of Iron Formed during the Roasting of Spathic Minerals.—M. Boussingault.—The crystals in question are ferrous oxide found in a chink of the wall of a roasting-furnace, where the ore treated is a spathic iron containing, besides the quartzose gangue, carbonates of manganese and lime, and from 45 to 55 per cent of protoxide of iron. The crystals are regular octahedra, magnetic without possessing polarity, and yield a black powder. In composition they approach closely to the natural magnetic oxide of iron.

Composition of Gun-Cotton.—Prof. F. A. Abel.—A reply to the paper of MM. Champion and Pellet (*Comptes Rendus*, lxxxiii., p. 707). Prof. Abel points out that he has never pronounced the gun-cotton of commerce to be trinitro-cellulose, as it generally contains a certain proportion of lower nitro compounds, of raw cellulose, of products furnished by the action of the acids upon the fatty or resinous matters enclosed in the fibre of cotton, and, lastly, of mineral bodies. The analysis of compressed gun-cotton can be effected by the ordinary combustion process.

New Electric Repulsion, and on its Application to the Theory of Comets.—E. Reitlinger and A. d'Urhanitzky.—If we approach the finger or any conductor to the luminous column produced in a Geissler tube we observe an attraction, which has been explained by the known laws of the electric influence. But on the 9th of March of this year we met with tubes in which the experiment, thus conducted, manifested, not an attraction, but a very distinct repulsion. These exceptional tubes have contained, according to M. Geissler, the one bromine and the other protochloride of tin. In addition to the repulsion there was observed in the tubes a green light, of a singular aspect, on the side towards which the luminous column was directed. Our researches showed us that this green light was due to a kind of electric phosphorescence, which we have described in the *Memoirs of the Academy of Vienna*. A spectroscopic examination did not reveal any distinction between the bromine tube and that which had contained protochloride of tin. In both cases the most distinct portions of the spectrum displayed those three well-known bands commonly attributed to the spectrum of carbon. They are the same bands which M. Vogel and others have designated as the spectrum of comets. This remarkable fact has drawn our attention to the relations between this repulsion and the repulsion exerted upon the tail of comets by the sun. The identity of the spectra may be explained by supposing that the gas introduced into the Geissler tubes no longer gives any light; that it is either absorbed by the electrodes or precipitated upon the glass; and that a trace of highly rarefied gas furnishes the luminous matter, the repulsive power of which has been observed.

Researches on the Vitality of the Ova of the Phylloxera.—M. Balbiani.—The ova have been exposed to the action of alkaline sulpho-carbonates, of bisulphide of carbon, of bichromate of potassa, and of empyreumatic bodies.

Treatment of Phylloxerised Vines.—M. B. Boiteau.—An examination of various measures, prophylactic and remedial.

Explanation of "Actio in Distans," Gravitation and Electric Action.—M. A. Picart.—All the phenomena of the universe may be explained by matter and motion *alone* without *forces acting at a distance*. For this pur-

pose it is sufficient to imagine infinite space filled with eternal matter consisting of a mass of atoms animated by a perpetual movement in all directions. This matter, the sub-stratum of the world, is what is commonly called *ether*. Only it has been hitherto regarded as a fluid whose molecules have in a state of equilibrium, fixed relative positions, each exerting upon the neighbouring molecules a repulsive action which give rise to vibratory movements whenever this equilibrium is disturbed by any cause whatsoever. According to the new theory of gaseous fluids (Clausius) we may henceforth conceive the ether as formed of *elastic* atoms moving with considerable speed in all directions, and producing at each point by their impacts upon an ideal elemental plane a determined pressure. From this new conception of the ether, which in nowise contradicts the ancient view, and which even includes it as a corollary (*Theorie mécanique de la chaleur*, de M. Briot) gravitation at once follows, *i.e.*, the mutual attraction of two material points in the ratio of their masses, and inversely as the square of their distance. As to electric actions they may be explained in an analogous manner. The material molecules in arranging themselves by their mutual attractions so as to form bodies must condense around themselves the ethereal atoms as atmospheres more or less dense, the elasticity of which must vary according to the relative positions of the molecules of the body. These are the atmospheres whose increases or diminutions of density or of elastic force constitute the electric condition —positive or negative—of the body. Between these atmospheres and the material molecules situate at a distance there must be exerted a gravitation like that of two material molecules. Between two condensed atmospheres of ether a repulsive action must be exerted, resulting from the necessary increase of the speed of the atoms which move in both directions from the one atmosphere to the other, and which produce upon each of them, on the side where they strike, an augmentation of pressure tending to remove them from each other. From these reactions we easily arrive at Coloumb's law of attraction or repulsion, the basis of all electrical theory.

Crystals of Gallium.—M. Lecoq de Boisbaudran.—The author has presented to the Academy crystals of metallic gallium. The values found for the angles appear to lead to a clino-rhombic form.

Determination of Sugars by means of Normal Solutions.—M. E. Perrot.—The author prepares a standard solution of copper by dissolving 39·275 grms. of sulphate of copper, very pure, and dried between several folds of filter-paper, and makes it up with distilled water to 1000 c.c. Each c.c. of this solution contains 0·01 of copper. On the other hand, he dissolves about 25 grms. of pure cyanide of potassium in 1 litre of distilled water. Of this solution 10 c.c. are taken and put in a flask, to which about 20 c.c. of ammonia are added, and the liquid is kept at a temperature of 60° to 70°. He pours in the copper solution drop by drop by means of a burette graduated into tenths of a c.c., until there appears the blue tint characteristic of salts of copper in an ammoniacal solution. The number of degrees of the burette are then read off, and indicate the quantity of copper which has been required to produce the reaction. The solution of the sugar in question (previously inverted if it is required to determine crystalline sugar) is then placed in contact with an excess of Fehling's liquor, and reduced in the water-bath. The whole is filtered in order to collect the precipitate of suboxide, which is first well washed with hot water, and dissolved in nitric acid, diluted with an equal volume of water, and a few fragments of chlorate of potassa are added. This solution is effected on the filter, which is then carefully washed in acidulated water. The filtrate, to which the washings are added, is then mixed with water enough to make up 100 or 150 c.c., and is then poured by means of the burette into 10 c.c. of cyanide, mixed with 20 c.c of ammonia as above, stopping when the blue colour appears, and reading off the quantity of copper employed. From the former experiment it is known how much copper 10 c.c. of the cyanide solution require. Hence it is easy to calculate the total amount of copper which has been present as suboxide. The amount of sugar is then found from the data that 9298 parts of copper equal 5000 of crystalline sugar, or 5263 of glucose.

Second Note on the Detection of Magenta in Wines.—M. Fordos.—(*First Method.*) 10 c.c. of wine are mixed with 1 c.c. of ammonia and 10 c.c. of chloroform, mixing the liquids by repeated inversions of the tube, but without shaking. The chloroform is separated by means of a funnel with a tap, and collected in a test-tube. A little water is added, so that there may be about 1 c.c. above the chloroform, and an excess of acetic acid is poured in. The magenta, re-formed, separates from the chloroform, and floats above it as an aqueous solution more or less strongly coloured. This experiment may be performed in three minutes, and shows the presence of magenta in wines down to about 1 m.grm. per litre. (*Second Method.*) Wine and ammonia as above are mixed merely with 5 c.c. of chloroform. When the latter has collected in the bottom of the tube a crystal of citric acid, weighing 2 to 3 grms., is dropped into it. The acid saturates the ammonia and reproduces the magenta, which is deposited upon the crystal with its well known and beautiful colour.

Gazzetta Chimica Italiana.
Anno vi., 1876, Fasc. vii. and viii.

On Certain Derivatives of Santonic Acid.—Prof. S. Cannizzaro.—The substances examined by the author are hydrosantonic acid and its salts, acetyl-hydrosantonide, benzol-hydrosantonide, hydrosantonamide, and metasantonic acid.

On the Crystalline Form of Certain Derivatives of Santonin.—Giovanni Struver.—This paper consists chiefly of tables of angles calculated and observed, and is accompanied by two diagrams.

On Methylic Santonate.—S. Cannizzaro.—A white crystalline substance, which melts at 86° to 86·5°, and may be represented by the formula $C_{15}H_{19}CH_3O_4$.

On Photosantonic Acid.—Fausto Sestini.—This acid is obtained either by the saponification of its ethers, obtained by the action of sun-light upon a solution of santonin in ethylic or methylic alcohol, or much more readily by means of solar action upon a solution of santonin in dilute acetic acid. The author describes both these methods, and examines the salts of the acid.

On Asparagin and Aspartic Acid.—Icilio Guareschi.—An examination of the action of urea upon asparagin, of aspartic acid and urea, of the halogens upon asparagin, as also of nascent hydrogen, phenol, and glycerin.

On the Determination of Nitrogen in Milk and in its Products.—G. Musso.—The author urges that the method of Will and Varrentrapp should be more carefully examined, and if its inaccuracies are proved, that it should either be modified or definitely abandoned.

Action of Hydrate of Soda upon the Amylic Alcohol of Slow Fermentation.—Luigi Balbiano.—The author finds that amylic alcohol, lævorotatory or inactive, distilled with excess of caustic soda, does not become dextro-rotatory, but the lævorotatory becomes inactive.

On the Preparation of Nitrate of Ethyl.—Giacomo Bertoni.—Nitrate of ethyl is prepared, according to the author's method, by the reaction of urea and nitric acid upon alcohol at 92 per cent.

Observations on Prof. Brugnatelli's Paper on the Alkaloid of Spoiled Maize.—Prof. Cesare Lombroso.—The poisonous principle of mouldy maize, when introduced into the tissues of a frog, brought on tetanic convulsions.

Chemico-Hygienic Examination of the Water of Marcia, at Rome.—C. Carbucci, B. Balestra, and F. Sestini.—Not suitable for abstraction.

On the Thermo-Electric Property of Sodium and Potassium.—V. Maccani and M. Bellati.—A lengthy paper, not fitted for useful abstraction.

Jahrbuch der K.K. G[illegible]sten Reichsanstalt, Wien. Vol. xxvi., 3.

Properties of Ferric Oxide at High Temperatures.—W. Suida.—As the results of an extensive series of experiments, which are described in detail, the author reaches the following conclusions:—1. Ferric oxide is not changed in the slightest at the highest temperature of a Bunsen burner, provided no reducing bodies are present. 2. Ferric oxide, alone or in silicates, is partially changed to ferrous oxide if the temperature is raised to a bright red heat or to the beginning of a white heat, also if the process is performed in an atmosphere of nitrogen. 3. The same change takes place by the fusion of ferric oxide, alone or in silicates, with borax or glass, also if the operation is carried on in nitrogen or carbonic acid gas. 4. Fusion of ferric oxide with borax in an atmosphere of oxygen causes the formation of but an exceedingly small quantity of ferrous oxide. 5. Hermann's method of determining the amount of ferrous oxide in a silicate by fusion with borax is not reliable, the results often being three times greater than the reality. 6. The most satisfactory decomposition of a silicate, with a view of determining the quantity of ferrous oxide is accomplished by heating in a sealed tube of Bohemian glass with a mixture of hydrofluoric acid and dilute sulphuric acid.

Repertorium für Experimental Physik, von Dr. Ph. Carl. xii. Band., Heft. 5.

This issue contains papers on the "Tension Curve of Saturated Water," by Dr. Oscar Fabian; the Universal Lever," by K. Tschechowitsch; on the "Diffusion of Gases through Absorbent Substances," by Dr. S. von Wroblewski; "Apparatus for the Determination of the Specific Gravity of Gases, especially Coal Gas," by Prof. A. Wagner; "Indicator for Watercourses," by Dr. Hasler; "Monthly Averages of the Magnetic Declination and Horizontal Intensity, as taken in the Prague Observatory in 1875;" "Daily Variations in the Horizontal Intensity of Terrestrial Magnetism at Prague in 1867-1875;" "Dependence of the Co-efficients of Internal Friction of Gases upon Temperature," by A. V. Obermayer; "On the Magnetism of Soft Iron Cylinders, with an Appendix on the Magnetism of Various Hard Steels," by Dr. Chr. Ruths.

None of the papers are capable of useful abstraction, and all the more important require illustrations.

MEETINGS FOR THE WEEK.

MONDAY, Jan 8th.—London Institution, 5.
—— Medical, 8.
[illegible] Geographical, [illegible]
TUESDAY, 9th.—Physical, [illegible]
—— Asiatic, [illegible] Institution, 3
—— Royal Institution, 3. Prof. Odling on "The Basis of Life."
WEDNESDAY, 10th.—Geological, 8.
[illegible]
[illegible] Microscopical, 8
—— Quekett Club, 8.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

NOVEMBER, 1876.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Chlorine used to Oxidize Organic Matter.	Total Solid Matter.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Clear	0·000	0·007	0·120	0·043	23·31	8·231	0·432	1·01	1·412	14·3	4·2
West Middlesex	Clear	0·001	0·006	0·165	0·038	19·[illegible]	8·624	0·468	0·94	1·534	14·3	5·3
Southwark and Vauxhall	Slightly turbid	0·001	0·010	0·120	0·038	20·42	8·512	0·468	0·94	1·271	14·8	3·7
Chelsea	Slightly turbid	0·000	0·006	0·168	0·039	20·80	8·680	0·576	1·01	1·071	14·3	2·8
Lambeth	Slightly turbid	0·001	0·005	0·180	0·038	20·60	9·016	0·468	1·01	1·411	14·8	4·2
Other Companies.												
Kent	Clear	0·000	0·002	0·330	0·014	29·12	10·640	0·684	1·37	2·869	18·8	5·1
New River	Clear	0·001	0·004	0·165	0·014	19·31	8·680	0·396	0·87	1·281	14·8	2·0
East London	Clear	0·000	0·004	0·120	0·034	22·[illegible]	8·969	0·612	1·08	1·611	15·9	3·3

The quantities of the several constituents are stated in grains per imperial gallon of 70,000 grains.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

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THE CHEMICAL NEWS.

VOL. XXXV. No. 894.

ON SOME BLOWPIPE REACTIONS.*

By E. J. CHAPMAN, PH.D.,
Professor in University College, Toronto.

I. *On the Reactions of Metallic Thallium before the Blowpipe.*

THE following reactions are given from direct experiments by the writer:†—

In the closed tube thallium melts easily, and a brownish red vitreous slag, which becomes pale yellow on cooling, forms around the fused globule.

In the open tube fusion also takes place on the first application of the flame, whilst the glass becomes strongly attacked by the formation of a vitreous slag, as in the closed tube. Only a small amount of sublimate is produced: this is of a greyish white colour, but under the magnifying glass it shows in places a faint iridescence.

On charcoal, *per se*, thallium melts very easily, and volatilises in dense fumes of a white colour, streaked with brown, whilst it imparts at the same time a vivid emerald-green colouration to the point and edge of the flame. If the heat be discontinued the fused globule continues to give off copious fumes, but this action ceases, at once, if the globule be removed from the charcoal. A deposit, partly white and partly dark red, of oxide and teroxide is formed on the support; but, compared with the copious fumes evolved from the metal, this deposit is by no means abundant, as it volatilises at once where it comes in contact with the glowing charcoal. If touched by either flame it is dissipated, immediately, in imparting a brilliant green colour to the flame border. The brown deposit is not readily seen on charcoal; but if the metal be fused on a cupel, or on a piece of thin porcelain or other non-reducing body, the evolved fumes are almost wholly of a brownish colour, and the deposit is in great part brownish black. It would appear, therefore, to consist of Tl_2O_3, rather than of a mixture of metal and oxide. On the cupel, thallium is readily oxidised and absorbed. It might be employed, consequently, as suggested by Crookes, in place of lead, in cupellation; but to effect the absorption of copper or nickel a comparatively large quantity is required. When fused on porcelain the surface of the support is strongly attacked by the formation of a silicate, which is deep red whilst hot and pale yellow on cooling.

The teroxide, as stated by Crookes, evolves oxygen when heated, and becomes converted into TlO. The latter compound is at once reduced on charcoal, and the reduced metal is rapidly volatilised with brilliant green colouration of the flame. The chloride produces the same reaction, by which the green flame of thallium may easily be distinguished from the green copper flame, the latter, in the case of cupreous chlorides, becoming changed to azure-blue. With borax and phosphor-salt, thallium oxides form colourless glasses, which become grey and opaque when exposed for a short time to a reducing flame. With carbonate of soda they dissolve to some extent, but on charcoal a malleable metallic globule is obtained. The presence of soda, unless in great excess, does not destroy the green colouration of the flame.

Thallium alloys more or less readily with most other metals before the blowpipe. With platinum, gold, bismuth, and antimony, respectively, it forms a dark gray brittle globule. With silver, copper, or lead, the button is malleable. With tin, thallium unites readily, but the fused mass immediately begins to oxidise, throwing out excrescences of a dark colour, and continuing in a state of ignition until the oxidation is complete. In this, as in other reactions, therefore, the metal much resembles lead.

II. *On the Opalescence produced by Silicates in Phosphor Salt.*

It is well known that most silicates when fused with phosphor-salt are only partially attacked, the bases, as a rule, gradually dissolving in the flux, whilst the silica remains in the form of a flocculent mass technically known as a "silica skeleton." Very commonly, almost invariably, indeed, if the blast be long continued, the bead becomes more or less milky or opalescent on cooling. This latter reaction was apparently regarded by Plattner as essentially due to the presence of alkaline or earthy bases, such as exhibit the reaction *per se*. He states (*Probirkunst: Dritte Auflage*, 468):—"Da man nun von mehreren Silikaten ein Glas bekommt, welches, so lange es heiss ist, zwar klar erscheint, aber unter der Abkühlung mehr oder weniger opalisirt, so muss man sich von der ausgeschiedenen Kieselsaure überzeugen, so lange das Glas noch heiss ist, und dabei die Loupe zu Hülfe nehmen. Die so eben erwähnte Erscheinung tritt gewöhnlich bei solchen Silikaten ein, deren Basen Kalkerde, Talkerde, Beryllerde oder Yttererde sind, die für sich mit Phosphorsalz, bei gewisser Sättigung des Glases, unter der Abkühlung oder durch Flattern milchweiss oder opalartig werden." Dr. Theodor Richter, the editor of the fourth edition of Plattner's work, leaves out the "gewöhnlich" of the above quotation, and so makes the implication still stronger. In this *vierte Auflage* the statement runs—"Bei solchen Silikaten deren Basen für sich mit Phosphorsalz, bei gewisser Sättigung des Glases, unter der Abkühlung oder durch Flattern milchweiss oder opalartig werden (Kalkerde, Talkerde, Beryllerde, oder Yttererde) wird die Perle unter der Abkühlung mehr oder weniger trübe." It is true enough that silicates in which these bases are present exhibit the reaction; but as other silicates—practically all, indeed—exhibit the reaction also, the inference implied in the above statement is quite erroneous. The opalescence of the glass arises entirely from precipitated silica. If the blast be sufficiently kept up, a certain amount of silica is almost always dissolved, but this becomes precipitated as the glass cools. A simple experiment will show that this is the true cause of the opalescence. If some pure silica (or a silicate of any kind), in a powdered condition, be dissolved before the blowpipe flame in borax until the glass be nearly saturated, and some phosphor-salt be then added, and the blowing be continued for an instant, a precipitation of silica will immediately take place, the bead becoming milky—or, in the case of many silicates, opaque-white—on cooling. This test may be resorted to for the detection of silica in the case of silicates which dissolve with difficulty in phosphor-salt alone, or which do not give a well-pronounced "skeleton" with that reagent.*

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* Communicated by the Author.

† The reactions given by Crookes are as follows:—"The metal melts instantly on charcoal, and evolves copious brown fumes. If the bead is heated to redness, it glows for some time after the source of heat is removed, continually evolving vapours which appear to be a mixture of metal and oxide. A reddish amorphous sublimate of protoperoxide surrounds the fused globule. When thallium is heated in an open glass tube, it melts and becomes rapidly converted into the more fusible protoxide, which strongly attacks the glass. This oxide is of a dark red colour when hot, solidifying to a brown crystalline mass. The fused oxide attacks glass and porcelain, removing the silica. Anhydrous peroxide of thallium is a brown powder, fusing with difficulty and evolving oxygen at a red heat, becoming reduced to the protoxide. The phosphate and sulphate will stand a red heat without change."

* By whom was the formation of a "silica skeleton" first made known? There is no reference to it in the early treatise of Von Engerstrom attached to his translation of Cronstedt's "Mineralogie" (ed. 1, 1770; ed. 2, by John Hyacinth de Magellan, 1788), although phosphor-salt is mentioned as a reagent under the term of *sal fusible microcosmicum*, and was indeed used by Cronstedt before 1758, the year in which his "Mineralogie" was anonymously published. Bergmann, who followed as a blowpipe worker, states that "siliceous earth" is very slowly attacked by microcosmic salt, but he does not

III. *On the Reactions of Chromium and Manganese with Carbonate of Soda.*

When a mineral substance is suspected to contain manganese it is commonly tested by fusion with carbonate of soda. But chromium compounds form with that reagent a green enamel much resembling that formed by compounds of manganese.

The chromate-of-soda enamel, however, is yellowish green after exposure to an oxidating flame, and the green colour never exhibits any tinge of blue.

The manganate-of-soda enamel, on the other hand, is generally greenish blue when quite cold.

To avoid, however, any risk of error in the determination, the bead may be saturated with vitrified boracic acid until all the carbonic acid is expelled, and a clear glass is obtained. The chrome glass will retain its green colour, whilst the manganese glass will become amethystine or violet. In place of boracic acid, silica may be used if more convenient. In this case the reaction is assisted by the addition of a very small amount of borax.

IV. *On the Detection of Cadmium in the Presence of Zinc, in Blowpipe Experiments.*

When cadmiferous zinc ores, or furnace products derived from these, are treated in powder with carbonate of soda on charcoal, the characteristic red-brown deposit of cadmium oxide is generally formed at the commencement of the experiment. If the blowing be continued too long, however, this deposit may be altogether obscured by a thick coating of zinc oxide. When, therefore, the presence of cadmium is suspected in the assay substance, it is advisable to employ the following process for its detection:—The substance, if in the metallic state, must first be gently roasted on a support of porcelain or other non-reducing body. Some of the resulting powder is then fused with borax or phosphor-salt on a loop of platinum wire, and bisulphate of potash in several successive portions is added to the fused bead. The latter is then shaken off the wire into a small porcelain capsule, and treated with boiling water. A bead of alkaline sulphide is next prepared by fusing some bisulphate of potash on charcoal in a reducing flame, and removing the fused mass before it hardens. A portion of the solution in the capsule being tested with this, a yellow precipitate will be produced if cadmium be present. The precipitate can be collected by decantation or filtration, and tested with some carbonate of soda on charcoal. This latter operation is necessary, because if either antimony or arsenic were present an orange or yellow precipitate would also be produced by the alkaline sulphide. By treatment with carbonate of soda on charcoal, however, the true nature of the precipitate would be at once made known.

To be continued.)

ON THE GROWTH OF THE ALKALI AND BLEACHING-POWDER MANUFACTURE OF THE GLASGOW DISTRICT.†

By JAMES MACTEAR.

(Continued from p. 5.)

Part II. Sulphuric Acid.

The substitution of dilute sulphuric acid for sour milk in the old system of bleaching, which had the effect of reducing the time required by nearly one-half, gave rise to a demand for vitriol in considerable quantity, and to supply this demand a work was erected in 1749, at Prestonpans.

I have been unable to find any evidence of the manufacture of sulphuric acid in Scotland previous to this date.

As is well known, the first method of producing sulphuric acid was by the distillation of sulphate of iron or *green vitriol*.

This was followed by a method of burning sulphur under a bell glass moistened with water, and the acid (produced in very small quantity) is said to have been sold at 2s. 6d. per oz.

In 1740, MM. Lefévre and Lémery proposed the addition of nitrate of potash to the sulphur, and suggested that the combustion could then be carried on in closed vessels. This idea was taken up in England by a Dr. Ward, who used large glass vessels holding about 300 litres, and containing at the bottom a small quantity of water.

A small capsule, supported on a stoneware stand, was charged with a mixture of one of nitre and eight of sulphur. This was set on fire and the neck of the vessel closed. After the combustion had ceased, fresh air was allowed to enter the vessel, and these operations were repeated until the acid was sufficiently strong for concentration in glass retorts. This acid was sold at about 2s. per lb.

Dr. Roebuck, of Birmingham, improved on this process by erecting a leaden vessel of about 6 ft. square as a substitute for the glass ones previously in use. This was in 1746, and works were erected by this gentleman and a Mr. Garbett, in the year 1749, at Prestonpans, on the east coast of Scotland.

This, then, was the beginning of the sulphuric acid manufacture in Scotland. Other works were soon erected, and in 1797 there were in Glasgow alone at least six or eight different works.

In this year the question of the strength of the commercial vitriol seems to have received a good deal of attention, and a set of hydrometers were invented or arranged by a Mr. Foy, a chemist at that time engaged in bleaching operations.

The following is a note of the cost of manufacturing 950 bottles of vitriol (of 150 lbs. each).

"*Mr. M——'s Business*, 1798."

25 tons sulphur—say at £40		£1000	0 0
7 „ nitre „ 100		700	0 0
Coals		105	0 0
Wages and houses for men		250	0 0
Tear and wear of utensils		30	0 0
Rent and buildings		70	0 0
Cartages		40	0 0
		£2195	0 0
142, 500 lbs. o. v. at 6½d.	£3859 17 6		
Less discount at 10 per cent	385 19 9		
		3473	17 9
Profit		£1278	17 9

This gives nearly 64 tons of acid, costing, say, £32 per ton, and selling for, say, £54 net cash.

Description of method of working then in use by Messrs. Bealy and Radcliffe, near Manchester:—

May, 1799.—"There were six chambers, 12 ft. by 10 ft. by 10 ft., roofed like a cottage. They were placed in houses having openings in the brick walls, leaving the lead to be exposed to the atmosphere.

"This is perhaps of more use in expediting the filling of the chambers with fresh air than in aiding condensation. Mr. Laird (a Glasgow manufacturer of the period) says that the hotter the chambers are kept the condensation is the more perfect.

"Each of these chambers has a valve, which is opened between the burnings.

"In them there is burned each week 1386 lbs. sulphur and 198 lbs. nitre, burnt in double pans, the larger above

seem to have remarked the skeleton formation in the case of any silicate. The reaction appears to have been first definitely pointed out by Berzelius in his standard work on the Blowpipe, published in 1821. It was therefore most probably discovered by him, or perhaps—as he lays no claim to its discovery, whilst claiming to be the originator of other tests—it may have been communicated to him by Gahn.

† Read before the Chemical Section of the British Association, Glasgow Meeting, 1876.

the lesser, and yielding 1800 lbs. of O.V. of 1·8 sp. gr. (equal to a produce of 130 per cent on sulphur, with 14·28 per cent of nitre).

"8 to 9 inches of water on the floor of the chamber.

"The sulphur and nitre are mixed in the proportion of one of nitre and seven of sulphur.

"Of this mixture 8 lbs. are burned in each chamber every four hours. The mixture is burned on iron plates or trays, of which there are two sets only in each chamber (more not being found so productive), each set consisting of two plates, one placed over the other, about 3½ inches apart.

"The iron is of best quality and very thin, so that they heat quickly. They are supported on a frame, which can be drawn out at the door of the chamber.

"One pound weight of the mixture is put upon a lower plate, and 3 lbs. on the upper plate.

"The plates being charged, the lower plates are first ignited, and when fairly lit, then the upper plates; the frame is then pushed into the chamber and the door shut.

"The whole will be finished burning in one hour.

"Charge again three hours, after the burning is over, or once every four hours, opening the doors and valves a quarter of an hour beforehand.

"The plates to be cleaned each time.

"By keeping this going on, they, in six weeks, make their O.V. attain a gravity of 20 ozs. (1·250 sp. gr.), when it is run off for concentration to 22 ozs. (1·375 sp. gr.), when it is used for bleaching liquors, &c.

"Having six chambers, therefore, affords one for drawing off each week.

"*State agreeable to the above.*

"1386 lbs. sulphur, at £22	£13	12	3
"198 „ nitre „ 64	5	13	1½
"Labour	1	1	0
"Tear and wear	1	1	0
	£21	7	4½
"Off for drawback on sulphur, at £6 12 8 per ton	4	2	0½
"Producing 1800 lbs. O.V., costing	£17	5	4

"Equal to 2½d. per lb. or £21 10s. per ton.

"Interest on sunk capital omitted in this state."

The prevalent theory held at this time may be seen from the subjoined note.

"When sulphur is heated to 302°, it burns with a blue flame, and the produce is chiefly sulphurous acid.

"When sulphur is heated to 570° it burns with a white flame, and the produce is sulphuric acid."

Numberless experiments were conducted with the view of being able to burn the sulphur at the proper degree of heat which should yield only sulphuric acid.

The fact that a quantity of nitrate of potash only equal to 1-8th of the oxygen required was sufficient for practical purposes, seems to have given rise to the most extraordinary ideas at this time.

The following calculations give a good illustration:—

"100 of nitrate of potash according to Kirwan, contains 41·2 of nitric acid, 46·15 potash, and 12·83 water.

"The acid of nitre consists of 7 of oxygen and 3 of azote; hence 100 nitrate of potash contains 28·7 of oxygen.

"100 of sulphur, it appears, from Kirwan, requires 140 of oxygen to saturate it, or convert it all into sulphuric acid.

"100 acid, therefore, consists of 41·67 sulphur and 58·33 oxygen.

"Consequently 100 sulphur would require the oxygen of 525 of nitrate of potash for complete saturation.

"When, therefore, the maker of sulphuric acid adds 10 of nitre to 100 of sulphur, he has only 2·8 of oxygen, which will saturate only 2 of sulphur.

"Now 10 of nitrate of potash contains 4·612 of alkali; that alkali is converted into sulphate of potash, and requires for this 4·5 sulphuric acid in that state in which it exists in the sulphate of potash (it contains, by Kirwan, 45 acid and 55 potash). *That is, the potash of the nitre takes more acid than is produced by the oxygen contained in the nitre with its proper proportion of sulphur.*

"The nitre, therefore, used in the manufacture of sulphuric acid does not produce *any* acid which the manufacturer can be the better of. It produces no sulphuric acid in an uncombined state. The only other purpose it can serve is to produce such rapid inflammation of the sulphur as will be productive of sulphuric instead of sulphurous acid; *that is, it produces a white flame and the temperature of* 570°.

"Even with nitre a great deal of blue flame is present, and consequently much sulphurous acid formed, and this sulphurous acid is all lost to the manufacturer, as it flies off in the operation.

"The manufacturer, at most, produces from 100 sulphur, 168 of marketable oil of vitriol of 1·846 sp. gr.

"But 100 parts of sulphuric acid at this strength is equal to 89 at 2·000, which Kirwan calls his standard acid, and 100 standard acid is equal to 89·25 of acid, such as exists in sulphate of potash, or 100 parts acid at 1·846 sp. gr. are equal to 78, as existing in sulphate of potash.

"The manufacturer, therefore, only gets 125·6 acid, such as exists in sulphate of potash, whereas 100 parts sulphur should produce 240 parts of such acid, deducting 2 parts, which go to form the sulphate, leaving 238 parts.

"These 238 parts are equal to 290 at 1·846 sp. gr., which ought to be the produce, instead of 168.

"Hence only 55 parts of the 100 sulphur used go to form sulphuric acid, and 45 parts are lost.

"Some part of this 45 may indeed be impurities—allow 5 per cent on this account—still the manufacturer loses 40 parts in every 100 of sulphur.

"This 40 parts is converted into sulphurous acid, and is lost."

The only way to prevent this is to burn the sulphur with a white flame, and by raising the temperature in which it is burnt to 570°.

At the Prestonpans Works in 1800 *they used, per* 112 *lbs of O.V.*:—

100·8 lbs. of sulphur, at 7s.. ..	£0	6	3
13·06 „ nitre, at 36s.	0	4	2
All other expenses	0	10	7
Cost delivered to purchasers ..	£1	1	0

The selling gross price being about £60 per ton. This is equal to a production of, say, 198 per cent acid, 1·84 sp. gr., with 13 per cent nitre.

The size of these chambers was most likely the same as given in 1813, when they had 108 chambers, 14 ft. long, 10 ft. high, and 4½ ft. wide. In 1805, a work existed at Burntisland which employed no less than 360 chambers, each 8 ft. long, 6 ft. high, and 4 ft. wide, containing 192 cubic ft. each.

Water equal to 70 or 80 gallons (5 to 6 inches) was run on the bottom, and the charge was 1 lb. of a mixture of 1 nitre to 6 of sulphur every four hours, half an hour allowed for ventilation.

The burning was continued for ten weeks, in which time 36 chambers yielded 60 bottles rectified acid. This being the weekly produce of the works:—

Produce .. .. 173 per cent O.V., 1·84 sp. gr.
Nitre .. .. .. 16·6 „

Many more such details might be given, but it will be more instructive to trace the development of this manufacture in the progress of the St. Rollox Chemical Works.

These works were erected in 1799, for the production of bleaching-powder, a patent for which had been secured by Mr. C. Tennant in the previous year. Considerable quantities of sulphuric acid were required for this manufacture, and were purchased from the various local makers, from the Prestonpans Vitriol Company, and supplies were even brought from Halifax.

The price at this time being about £60 per ton delivered.

The consumption increasing rapidly, chambers were erected at St. Rollox in 1803; these were six in number, and seem to have been 12 ft. by 10 ft. by 10 ft., costing to erect about £40 each.

The house in which they were contained was of three floors, about 50 ft. long by 24 ft. wide—the upper containing the chambers, the next the glass retorts for concentrating the acid, and the lower the leaden evaporating boilers, used in bringing the acid up to strength for the glass retorts.

The system upon which these chambers were worked, was that as already described as in use by Messrs. Bealy, and the quantity of sulphur burned was about 1000 lbs. weekly, with about 14 per cent nitre.

Various modifications of this system were tried, chiefly to improve the yield by charging less often, until the question of how to deal with the residues became a serious one, and in 1807 a third plate was added, on which the residues, or "sulphur ashes," were re-burned, mixed with a little fresh nitre.

This succeeded so well that considerable quantities of these residues were purchased from the other makers over the country, and used up in this way.

These sulphur ashes contained from 25 to 50 per cent when only once burned, and cost about £5 per ton.

At the end of this year, a brick furnace, heated artificially, was attached to one chamber, and in a short time two chambers were attached to one furnace, which was placed between them and had a flue to each chamber.

The furnace burned the sulphur ashes mixed with a portion of fresh sulphur and nitre. It worked almost continuously, the gas passing into one chamber for a certain time, the other meanwhile being shut off by means of a damper, then the first chamber damper was closed and the second opened. No. 1 chamber was allowed to condense for some time, and then the air valves and doors were opened to let in a fresh supply of air.

There were 14 chambers at work in this year, during which a produce of about 200 of acid of 1·84 sp. gr. seems to have been obtained from 100 sulphur with 15 per cent nitre. At the end of 1809, there were in operation 26 chambers.

In 1811, furnaces heated externally were applied to all the chambers, which were increased in number to 32, arranged in sets of two or three each.*

Sulphur ashes were used in large quantity.

The strength of the chamber acid, which had hitherto only been about 50 to 60 T., was gradually raised, and steam having been introduced about 1813 or 1814, a strength of 100° to 120° T. was attained, and the process became more or less a contipuous one.

From this time till about 1840, the changes in the manufacture were chiefly in the direction of improving the form of the apparatus, both in chambers and furnaces.

Pyrites was first used in 1840.

Communications with Hill, show that he was using pyrites in 1820 in a chamber 50 ins. by 26 ins. by 22 ins.; and Gay-Lussac's method of recovering the nitrous compounds by absorbing them in strong vitriol, in 1844 introduced by a Mr. De Courcy.

This was followed almost immediately by Mr. C. T. Dunlop's method of manufacturing bleaching-powder by the decomposition of a mixture of salt and nitrate of soda, which gives off a mixture of chlorine and nitrous acid. The latter is absorbed in strong vitriol and used as the source of nitrous acid in the chambers.

Various methods of denitrating this nitrous vitriol were from time to time tried, and the most successful, perhaps, prior to the introduction of the Glover tower was a wall of coke extending across the chamber, through which all the gases had to pass while it was kept supplied with nitrous vitriol at various points so as to expose it in as thin films as possible. This method worked extremely well for many years.

The methods now in use in the manufacture at these works differ but little from the general system in use by the other large manufacturers of Great Britain.

The following list of vitriol makers in England is interesting, compiled in 1820.

Rolled plate of about a foot square and ¾ inch thick in use generally by the makers.

Chronology—Sulphuric Acid—Glasgow, &c.

Works.	Date.	No. of Chambers.	Length.	Breadth.	Height.	Method of Burning.	Produce from 100 Sulphur at 1·84 sp. gr.	Per cent Nitre.	Cost per Ton.	Remarks.
			Feet.	Feet.	Feet.				£.	
Mr. M——'s..	1798	—	—	—	—	On plates	200?	28	32	25 tons sulphur, strength of acid unknown, if 148° yield would be 200%.
Bealy's	1799	6	12	10	10	,,	130	14½	21 10/	Cottage roofs—run off each 6 weeks.
Prestonpans ..	1800	108	14	4½	10	,,	198	13	21	Cost delivered to customers—run off in 10 weeks.
Burntisland ..	1805	360	8	4	6	,,	173	16 6	—	Cost not known.
Nisbet	1805	—	—	—	—	—	187	25	29	Small work.
A. W. and Co.	1805	6	—	—	—	—	187	19	28 15/	
W. N.	1811	—	—	—	—	—	200	23	—	Sulphur ashes re-burnt on red-hot plates.
Prestonpans ..	1812	108	14	4½	10	—	220	Unknown	—	Do. Do.
Do. ..	1813	108	14	4½	10	—	—	—	—	400 to 500 glass retorts at work two charges per wk. Chambers in 9 sets of 12 each, 1 set run off each week.
Kenny, Dublin	1813	?	45	17	10	—	—	—	—	
			25	17	12					
J. L——d ..	1813		—	—	—	—	200	20·8	—	
Camlachie ..	1820	—	—	—	—	—	263*	13	—	*Acid strength supposed to be 144°T.
Porte Dundas	1824	1	70	18	—		246*	—	—	Do. Do.
St. Rollox ..	1803	6	12?	10?	10?	—	—	14	—	
Do. ..	1806	—	—	—	—	—	185	12	20 13/	
Do. ..	1807	—	—	—	—	—	193	15½	18 15/	
Do. ..	1809	26	No Record			—	—	—	—	
Do. ..	1811	32	60?	14?	12?	Furnace	—	—	—	

Name.	Situation of Works.
Brandrum and Co.	London.
Farmer	,,
Smith	,,
Hill	,,
D. Taylor and Sons	,,
Liddiard	,,
Dobbs	,,
Skey and Beudley	Staffordshire.
Caves and Co.	Bristol.
Bush	,,
Dobbs	Birmingham.
Austen	,,
Phipson	,,
Paton	,,
Bower and Sons	Leeds.
Norris and Son	Halifax.
Betson	Rotherham.
Doubleday, Easterby, & Co.	Newcastle.
Rawson and Sons	Bolton.
,, ...	,,
Watkins	Manchester.
Mutrie and Co.	,,
,, ...	Whitehaven.

23 works in all at this date.

(To be continued).

NOTE ON A CRYSTALLISED COMPOUND OF SALT AND WATER.

By E. BEVAN.

Sodic chloride is to a certain extent soluble in hot hydrochloric acid. This solution deposits on cooling long needle-like crystals composed of salt and water. A specimen of the dried crystals gave on analysis the following results:—

NaCl	94·50 (mean of 4 analyses)
H_2O..	5·48

They contained only a very slight trace of hydrochloric acid. After a time the crystals appear to break up into the ordinary form of salt crystals containing no water.

ON THE CALCULATION OF THE PERCENTAGE OF CHEMICALLY COMBINED CARBON IN ANALYSES OF STEELS BY EGGERTZ'S COLORIMETRIC METHOD.

By SERGIUS KERN, St. Petersburg.

I SUPPOSE that in many laboratories of iron works, where a couple of analyses of steel-castings are made every day analysts prepare tables by means of which, knowing the quantity of c.c. of the normal and specimen solutions of steels used to receive an equal colouration, the percentage of carbon is easily found out.

The following remarks may be of some use, especially as no method for a quick calculation of carbon can be found in manuals of chemistry; even Eggertz in his book on Iron Analyses gives no information on this subject. Eggertz's colorimetric method is well known, so that it is of no use explaining it. I merely mention that it is better to dissolve the normal steel and the specimen in equal quantities of nitric acid (8 c.c.), and in comparing the test-liquors to dilute them by nitric acid, 1·2 sp. gr., instead of using water as recommended by Eggertz.

In all my examples for calculating the percentage of carbon I suppose having 8 c.c. of the normal solution, prepared from 0·1 grm. of normal steel containing 0·31 per cent of carbon, very carefully determined by the combustion method. On the other hand, 8 c.c. of the specimen solution is prepared from 0·1 grm. of the analysed steel.

In calculating the percentage of carbon two cases may happen:—

1. The specimen solution is *darker* in colour than the normal solution.
2. The specimen solution is *lighter* in colour than the normal solution.

I. *The specimen solution is darker.* 8 c.c. of the normal solution contains 0·31 per cent of carbon: hence 1 c.c of the same solution contains—

$$\frac{0{\cdot}31}{8} = 0{\cdot}0038 \text{ per cent of carbon.}$$

In comparing the specimen solution it was diluted by

ANALYSES OF IRON ORES, LIMESTONES, COALS, &c., USED IN THE IRON MANUFACTURE IN SCOTLAND.

By WILLIAM WALLACE, PH.D., F.R.S.E., F.C.S., Public Analyst for Glasgow, &c.

TABLE I.—SCOTTISH BLACKBAND IRONSTONE, RAW AND CALCINED.

Constituents.	I.	II.	III.	IV.	V.	VI.	VII.	VIII. Slatey band.	IX. Slatey band.
Protoxide of Iron	32·14	41·65	44·19	45·78	46·59	42·02	47·31	32·14	29·83
Protoxide of Manganese	1·05	—	1·93	1·12	1·12	0·82	1·67	0·96	1·48
Lime	2·82	5·76	2·22	1·79	1·63	3·65	1·79	0·83	2·37
Magnesia	1·08	3·52	0·91	1·30	2·25	3·54	1·73	1·05	0·30
Carbonic Acid	22·87	33·06	30·74	30·05	32·19	32·61	32·71	21·64	21·13
Phosphoric Acid	0·82	0·84	0·43	0·55	0·78	0·46	0·59	0·43	0·24
Sulphur	0·22	0·25	0·22	3·28	0·14	trace	trace	7·48	9·50
Iron combined with Sulphur ..	0·19	0·22	0·19	2·87	0·12	—	—	6·54	8·31
Alumina	7·06	0·96	0·92	1·28	2·34	2·64	0·80	4·12	1·44
Silica	12·40	0·52	2·12	1·60	3·41	4·40	1·20	7·12	1·90
Coal and Bituminous matter ..	18·60	11·16	15·52	7·85	8·97	9·12	10·40	17·17	22·70
Water	0·75	2·04	0·61	1·63	0·41	0·74	1·80	0·52	0·80
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Iron, per cent	25·19	32·62	34·56	38·47	36·36	32·68	36·80	31·54	31·51
Specific gravity	2·533	3·030	2·791	3·073	2·830	2·857	2·941	2·727	—
Yield of Calcined Ore, per cent	61·28	58·20	56·41	60·85	63·60	62·26	60·48	59·64	52·85
Iron in Calcined Ore, per cent.	41·10	56·04	61·27	63·23	57·16	52·50	60·85	52·88	59·61
Silica in Calcined Ore, per cent	20·24	0·90	3·76	2·63	5·41	7·06	1·98	11·94	3·60

(To be continued.)

1 c.c. of nitric acid, in order to obtain the tint of the normal solution. The total volume of this solution is hence 9 c.c.

$0{\cdot}0038 \times 9 = 0{\cdot}0342$ per cent of chemically combined carbon in the specimen analysed.

II. *The specimen solution is lighter.* In this case the normal solution must be diluted to obtain an equal tint with the specimen solution. 8 c.c. of the normal solution were diluted by 2 c.c. of nitric acid. The total volume of the liquor is hence 10 c.c. One c.c. of this solution contains—

$$\frac{0{\cdot}31}{10} = 0{\cdot}031 \text{ per cent of carbon.}$$

The volume of the specimen solution remains always in this case 8 c.c., so that the percentage is very easily found out:—

$0{\cdot}031 \times 8 = 0{\cdot}248$ per cent of carbon in the analysed specimen.

By means of these calculations, knowing the per cent of carbon in the normal steels, tables may be very easily calculated and prepared.

Obouchoff Steel Works, St. Petersburg.

PROCEEDINGS OF SOCIETIES.

THE CHICAGO CHEMICAL SOCIETY.

A few gentlemen interested in the advancement of the science of chemistry held a meeting at the Sherman House Club-room, Chicago, November 29, 1876, to consider the advisability of forming a chemical society. There were present Profs. Hayes, Siely, Ebert, Wheeler, Rodney Welch, J. T. Bergen, jun., and Prof. Garretson, who was elected Chairman. All the gentlemen expressed themselves in favour of organising an association. Its objects would be not only to keep its members abreast with the latest discoveries in the science, but also to further original research.

Some discussion followed as to whether the proposed society should be made a section of the Academy of Sciences, or start out on an independent footing. Prof. Hayes favoured the Academy, although it was true it had much degenerated now from its palmy days before the fire, when it ranked as the third institution of the kind in the country. He thought the extra expense of such a connection would be more than made up by the facilities it would afford in apparatus, chemical journals, &c. It was decided that after the association was formed it could then, if desirable, join the academy.

A formal motion was made by Prof. Welch that those present organise a chemical society, its name to be confirmed hereafter. The motion was carried unanimously.

The following gentlemen were appointed a Committee on Constitution and Bye-laws:—The Chairman, and Profs. Wheeler and Ebert.

The same gentlemen were then instructed to consider the best quarters to be occupied by the new society temporarily. The lecture-room of the Chicago Homœopathic College, and also that of the College of Pharmacy, were suggested. The Committee will bring in reports on both subjects at the next meeting.

The Secretary (Mr. Bergen) was instructed to inform local chemists of the organisation of the society, and to ask their co-operation.

After some further discussion it was decided to have the first paper read at the next meeting, and Prof. Wheeler was assigned to that duty.

NOTICES OF BOOKS.

Lessons in Electricity at the Royal Institution, 1875-6. By John Tyndall, D.C.L., LL.D., F.R.S. London: Longmans and Co., 1876.

This little work presents in the space of 113 pages a succinct account of the principal phenomena of frictional electricity. It comprises, in a somewhat condensed form, the short course "adapted to a juvenile auditory" which Dr. Tyndall gave at the Royal Institution last Christmas. The book is mainly distinguished from the fact that all the experiments are performed in the simplest possible manner; there is no elaborate apparatus, and the youngest student of science can make for himself almost every thing which he is directed to use. The subject-matter is divided into thirty-two sections, commencing with Historic Notes, and passing on to Attraction and Repulsion, Conduction and Insulation, Electrics and Non-Electrics, the Two-Fluid Theory, Induction, the Electrophorus and Machine, the Leyden Jar, Atmospheric Electricity, and the Return Shock. We must not neglect to refer specially to the third section, which is entitled the "Art of Experiment." An historic sketch of the science having been given, we must next study the facts, and learn to produce and extend them. "The art of producing and extending such facts, and of enquiring into them by proper instruments, is the *art of experiment*. It is an art of extreme importance, for by its means we can, as it were, converse with Nature, asking her questions, and receiving from her replies. It was the neglect of experiment, and of the reasoning based upon it, which kept the knowledge of the ancient world confined to the single fact of attraction by amber for more than 2000 years. . . . In this way you will come into direct contact with natural truth—you will think and reason, not on what has been said to you in books, but on what has been said to you by Nature. Thought springing from this source has a vitality not derivable from mere book knowledge."

Finally, Dr. Tyndall addresses some parting words to Head Masters on the subject of science teaching in their schools:—"To them, moreover, I would say, in words of friendly warning, make room for science by your own healthy and spontaneous action, and do not wait until it is forced upon you from without. The condition of things now existing cannot continue. Its simple statement suffices to call down upon it the condemnation of every thoughtful mind. With reference to the report of a Commission appointed last year to enquire into the scientific instruction of this country Sir John Lubbock writes as follows:—'The Commissioners have published returns from more than a hundred and twenty of the larger endowed schools. In more than half of these no science whatever is taught; only thirteen have a laboratory, and only eighteen possess any scientific apparatus. Out of the whole number, less than twenty schools devote as much as four hours a week to science, and only thirteen attach any weight at all to scientific subjects in the examinations.' Well may the Commissioners pronounce such a state of things to be nothing less than a national calamity! If persisted in, it will assuredly be followed by a reaction which the truest friends of classical culture in England will have the greatest reason to deplore."

A Practical Treatise on Materia Medica and Therapeutics. By Roberts Bartholow, M.A., M.D. New York: D. Appleton and Co., 1876.

The above treatise is, perhaps, the most philosophically written work on Materia Medica and Therapeutics which has yet appeared on the other side of the Atlantic. The subject is treated entirely from the therapeutist's point of view, and all chemical, pharmaceutical, and botanical details are left out. Dr. Bartholow begins by describing the various routes by which medicines are introduced into the organism; inhalation, transfusion, and hypodermic injection being specially dwelt upon. He next proceeds

to describe the medicines themselves, and their effects on the various organs, dividing them into five great classes, viz.—Those used to promote constructive metamorphosis; those used to promote destructive metamorphosis; those used to act on the nerves; purgatives of all descriptions; and, lastly, topical remedies. Beginning with aliments, Dr. Bartholow carries his readers through the different kinds of animal and vegetable foods, describing their particular uses in various forms of disease, with remarks on special plans of diet, including a general description of the grape, whey, milk, koumiss, and buttermilk cures. The different forms of water cure also come in for a large share of attention. The work now enters on the domain of medicaments proper, pepsin being taken as the boundary stone. The article on iodine and its preparations, which is particularly complete, may be taken as a typical specimen of the systematic manner in which Dr. Bartholow has handled his subject. He begins by giving a description of iodine and its preparations, their general properties and doses. This is followed by a list of antagonists, incompatibles, and adjuvants, or synergists as the author prefers to call them. Next we have an account of their physiological action, including the symptoms and effects of iodism. To this succeeds the therapy of the remedies, this division of the article naturally receiving the largest amount of attention, the whole concluding with a copious list of European and American authors who have written and experimented on the subject. It will be seen from this description that each article is an exhaustive monograph as far as therapeutics go. Many of the newer remedies—such as chloral hydrate, croton-chloral hydrate, amyl nitrite, apomorphia, gelsemium sempervirens, and jaborandi—are fully treated of, the information being brought down to the latest date.

Although the work is so complete in its individual treatment of each particular remedy that is described, we cannot help expressing surprise that certain drugs and compounds, which must be as well known in America as in Europe, should have been entirely omitted. Such an important article of diet as lime-juice is not even alluded to, and we can find no mention of bebceria sulphate, *Cannabis Indica*, sumbul, Bael, syrup of chloral, and several other preparations, which, being officinal in the British and other Pharmacopæias, should not have been passed over in silence.

The work is provided with a double index, one to the remedies, the other to the diseases. Both of them are far too meagre for such a work as the present. For instance, in the Index of Diseases one of the most important remedies in tetanus, hypodermic injection of morphia, is omitted, although fully described in the text, and hydrophobia is left out altogether. But these defects detract but little from the real value of the work, every page of which teems with information, the gathering together of which must have cost Dr. Bartholow many years of anxious toil. Perhaps the highest praise we can give it is to say that it must take its place in every therapeutist's library side by side with Flückiger and Hanbury's "Pharmacographia."

To the scientific chemist who glances through Dr. Bartholon's book, and looks on the subject from a purely chemical point of view, it must be a matter of surprise to find how few remedies have been sought for in the laboratory. Taking the last twenty years, the number of purely chemical remedies that have been introduced into pharmacy may be counted on the fingers, and yet during that time chemists have enriched the world with tens of thousands of artificial acids, alkaloids, and neutral bodies, some of which, *a priori*, ought surely to have a high therapeutical value. The vegetable alkaloids are amongst the most powerful weapons in the therapeutist's armoury, and their artificial congeners, many of which approach them so closely in atomic constitution, cannot be totally worthless. The field open for research in this direction is almost boundless, and if cultivated on true scientific principles ought to yield a large harvest.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—Allow me to trespass on your space in the character of a Fellow (indeed, as regards a period when I had more time on my hands, and, so far as mineral analysis went, a working Fellow) of the Chemical Society.

A dozen or so years ago I suggested that our Society should take upon itself the duties of an examining body. My proposal was instantly snuffed out. But that a test should exist of competency to exercise the profession of a chemist was then a crying want, and is far more so now, especially with the newly-created regiment of Public Analysts. To meet this want we have a separate "Institution of Chemists," as I am (unofficially) aware, in course of formation, and, I hope, with success. In fact, the river of scientific organisation *will* flow, increased by numerous affluents, and if the authorities of the Chemical Society will not bear the honourable burthens that are thereby all but forced upon them on their heads be the neglect.

But how is it, Sir, that we Fellows have never been consulted, called to any meeting, or officially communicated with in any way by the Council? Is a great movement to be dealt with without any reference to the constituency by our little Parliament? Is not this for our representatives to take upon themselves to be our masters rather than our servants? So far has this been carried out that I have been unable to obtain copies of counsel's opinion upon the powers of organisation under our charter, although I have applied for such, and have even been shown printed copies! And, though not at all behind the scenes of this absurd and needless mystery, I perceive that the very natural course of asking question produces a state of irritation, as if one had some malevolent motive in presuming to learn what, as a Fellow, I may fairly term one's own business! Evidently, though a council, a board of directors, or any corporation would not be wise in making the details of their proceedings known to their constituents, yet on the eve of a great and irrevocable movement it is very far from wisdom, courtesy, or respect to allow no opportunity outside their own body of gaining information, of forming a judgment, or expressing an opinion on such vital matters as are now in question. I call upon the Fellows to express their opinions upon this policy of secresy.

Let us shortly look into the matter so far as our involuntary ignorance will allow of our doing. The Charter of the Chemical Society is sufficiently broad to enable us to provide for most of the great wants proposed to be met by the formation of a new body not possessing any legal privilege, with a few exceptions, the one probably most important being the absence of any power in the Council to depute their functions to persons outside their body. This, however, would not preclude a sub-committee acting in the name of the whole.

I believe that we should obtain consideration for any proper representations made by us to Her Majesty, and I understand the Royal College of Surgeons successfully took a similar course some three years since, a very different thing, pray observe, from asking for a Charter for a new body.

Whether or not we should succeed in an application to have a pass examination, or one for honours, recognised I will not give an opinion upon. But a body of which the existence dates by no means from yesterday, and of which a judicious selection by ballot would rapidly raise the prestige, has a great advantage, if only in point of time, over the status of a new and unprivileged examining body!

Great is the British love of precedent and sub-division! I do believe if a society were formed to provide the poor

with soup-tureens, another, holding itself jealously separate, would spring up to provide covers! And I have actually been told that, inasmuch as the College of Physicians and Surgeons are little more than examining and licensing bodies, and that such societies exist as the Medico-Chirugical and others whereat to read papers, so in our case it is best to read our scientific, far more our professional, papers in one place and to examine in another! As if the colleges aforesaid would not have been in a far more exalted position if they also had shrewdly advanced with our times.

Surely, Mr. Editor, it is not even now too late to take action, to the satisfaction of the members of the new body and the *κυδος* of the old one. As a lawyer I fail to see insuperable difficulty, and, from a lay point of view, I think it only wants the will, good temper, and a certain amount of give-and-take to work as one body with an efficient plan. But there must be a cessation of official *vis inertiæ* and friction, and probably the nomination to the Council of the Chemical Society of several men who have taken a leading part in the present movement, and who would form a well qualified sub-committee of administration.

Allow me, in conclusion, to remark that my standpoint is simply a hearty wish for the prosperity of the old Society and success to the objects, even if carried out separately from it, of the new one. After my Etonian, University, Legal, and Regimental Examinations, I have had about enough of them, and am not in the least likely to offer any body, old or new, ten guineas to renew the agonising tortures of the past.—I am, &c.,

Marshall Hall.

13, Old Square, Lincoln's Inn, W.C.,
January 6, 1877.

ESTIMATION OF POTASSIUM AS ACID TARTRATE.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xxxiv., p. 249) is a letter from Mr. Robert Frazer Smith concerning my process for the "Estimation of Potassium as Acid Tartrate." If Mr. Smith means anything, he probably means that the process I publish is the same as what he published in the *Sugar Cane* more than two years ago. If he had waited to see the rest of my paper I do not think he would have advanced such a claim, and it is an unfortunate circumstance for him that his letter appears in the same number as the second part of my paper. The fortuitous circumstance that I mention that my researches on the estimation of potassium as acid tartrate originated in experiments on the process of Messrs. Duncan and Newlands does not increase the similarity between my process and what he suggested. Neither does the equally fortuitous circumstance that the *Sugar Cane* republished from the *American Chemist* another of my papers, in the "same number of the *Sugar Cane* or a previous one," show that I am guilty of omitting to mention what he considers as his previous claim.

At the date of the publication of Mr. Smith's paper I had already adopted tartaric acid for estimating potassium in sugar solutions, and communicated my results quite freely to chemists who came to my laboratory. I used the volumetric method, which eliminates errors from impurities thrown down with the acid tartrate. Although the process was infinitely more satisfactory than the one used by Mr. Smith, I considered it too crude for publication. It is only lately that the study of the action of acetate of sodium, and the determination of the proper strength of alcohol to be used, have given results which make my processes presentable.—I am, &c.,

P. Casamajor.

Brooklyn, December 28, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 23, December 4, 1876.

Preparation of Alcohol from the Sugar contained in the Leaves of the Beet.—M. I. Pierre.—The nature of this paper may be sufficiently understood from its title.

Measuring Rod of Iridio-Platinum of the International Geodesic Association.—G. Matthey.

Observations on the above Communication.—MM. H. Sainte-Claire Deville, Tresca, Dumas.

Mr. G. Matthey, of the firm of Johnson, Matthey, and Co., of London, has presented to the Academy of Sciences a measure of 4 metres executed in an alloy of platinum and iridium. The specific gravity of the alloy is 21·508, and its composition is found to be:—

Platinum	89·40	89·42
Iridium	10·16	10·22
Rhodium	0·18	0·16
Ruthenium	0·10	0·10
Iron	0·06	0·06
	99·90	99·96

The remarks of MM. Sainte-Claire Deville and Dumas are decidedly complimentary; those of M. Tresca somewhat ungracious.

New Method of Studying the Thermic Spectra.—M. Aymonnet.—The study of the thermic spectra of absorption with bodies raised to different temperatures may and should lead to a knowledge of the physical laws connecting the phenomena of the association and dissociation of bodies to the thermic and luminous phenomena.

Production of Carbonate of Soda by the Action of Chloride of Sodium in Solution upon the Carbonates of Lime and Magnesia in Presence of Vegetable Matter.—M. P. Pichard.—The author concludes from his experiments and observations that—(1) Carbonate of soda and calcic and magnesic chlorides often coexist in briny and gypsiferous waters which have remained in calcareous and dolomitic soils. (2) The carbonate of soda appears to be formed by the reaction of sodic chloride upon calcic and magnesic carbonates in presence of organic matter. (3) This reaction is, in fact, produced if we leave in contact in a dark place common salt, green leaves, water charged with carbonic acid, and a large excess of limestone. It is not produced in the absence of organic matter. (4) The presence of sulphate of lime is not necessary, and seems rather to produce a diminution of the effect. (5) The production of carbonate of soda under these conditions is accompanied by the formation of ammonia, but in a less quantity in waters charged with sulphate of lime.

No, 24, December 11, 1876.

Composition of Glass and Crystal among the Ancients.—M. E. Peligot.—The author is of opinion that the common glass and the plumbiferous crystal had formerly a composition which differed strikingly from that of corresponding modern products. Modern glass contains lime along with the alkali and silica. In ancient specimens lime is only found in a much smaller proportion. The crystal glass of antiquity was a silicate of lead without alkali.

General Method of Analysis for the Tissues of Vegetables.—M. E. Fremy.—The study of *organic substances*, so successfully pursued at present by a great num-

ber of chemists, should not cause us to overlook that of *organised bodies*, which are overlooked in these days, and which nevertheless are of great interest as revealing the compounds which are indispensable to the performance of the vital functions. The proximate analysis of vegetable tissues presents a difficulty which all chemists will understand, its object being to determine the composition of a structure formed of insoluble elements in neutral solvents. The principal tissues of plants, after exhaustion by neutral solvents, are formed by the organic association of the following bodies:—Cellulosic substances (cellulose, meta-cellulose, para-cellulose), vasculose, cutose, pectose, pectate of lime, nitrogenous compounds, and various mineral matters. Dilute cold hydrochloric acid decomposes the pectate of lime, and sets at liberty the pectic acid, which is then easily determined by means of alkalies. Dilute boiling hydrochloric acid transforms pectose into pectin, which is precipitated by means of alcohol. Ammoniacal cupric reagent dissolves the cellulose. Boiling hydrochloric acid renders para-cellulose soluble in the ammoniacal cupric reagent. Bihydrated sulphuric acid dissolves the cellulosic substances. Dilute and boiling potassa dissolves cutose. Potassa under pressure effects the solution of vasculose. Dilute nitric acid renders vasculose soluble in alkaline solution.

Polymer of the Oxide of Ethylen.—M. A. Wurtz.—Oxide of ethylen, which had been prepared in the summer of 1874, and left in a sealed tube, was found in about a year converted into a dry, solid, white crystalline body, melting at 56°.

Disengagement of Ammonia observed on the Rupture of Certain Bars of Steel.—M. Barré.—This phenomenon has been repeatedly observed at the works of Anina. Hard steel gave off a quantity of ammonia sufficiently strong to be perceived at some distance. Red litmus paper and turmeric paper on being applied to the fracture immediately changed their colour, the former to blue and the second to brown. If the broken surface was moistened bubbles of gas were seen escaping for a quarter of an hour. With softer steel the escape of ammonia was less manifest, but was nevertheless detected by means of test-paper, These observations refer to steel made in the gas-furnace by the Siemens' process, but the same phenomenon has also been recognised with Bessemer steel.

Les Mondes, Revue Hebdomadaire des Sciences, November 23, 1876.

A complimentary banquet in honour of M. Chevreul is about to be given by the Academy of Sciences on the 50th anniversary of his membership,

Under the heading "Unconscious Cerebration," there is an attack made upon certain members of the Anthropological Society of Paris for having promised to bequeath their brains to the Society for examination and dissection.

A peculiar phase of madness occurring among French cooks, and known as *folie des cuisiniers*, is due to the carbonic oxide given off by the charcoal stoves so largely employed in culinary operations. It is characterised by hallucinations of sight and hearing, vertigo, oppression, and syncope. The patient generally believes himself the victim of persecution.

Oenokrine is the name of a test-paper sold in Paris for the purpose of detecting the fraudulent colouration of wines. With a genuine red wine the colour produced is a greyish blue, which becomes lead-coloured on drying. With magenta and other aniline colours it turns a carmine red; with ammoniacal cochineal, a pale violet; with elder berries, the petals of roses, &c., a green; with logwood and Brazil wood, the colour of dregs of wine; with Fernambucca wood and phytolacca, a dirty yellow; with extract of indigo a deep blue. The manipulation required is very simple. A slip of the paper is steeped in pure wine for about five seconds, briskly shaken in order to remove the excess of liquid, and then placed on a sheet of white paper to serve as a standard. A second slip of the test-paper is then steeped in the suspected wine in the same manner and laid beside the former. It is asserted that 1-100,000th of magenta is sufficient to give the paper a violet shade, whilst a larger quantity produces a carmine red. The inventors of the test-paper, MM. Lainville and Roy, are also said to have discovered a method of removing magenta from wines without injuring their quality, a fact of some importance if it be true that several hundred thousand hectolitres of wine sophisticated with magenta are in the hands of merchants.

Analysis of the Gases of the Grotto del Cane.—M. Et. Finot.—Two analyses of gases taken in this cavern, and preserved in bottles hermetically sealed, gave the following results:—

Carbonic acid	25·38	25·69
Oxygen	18·46	20·13
Nitrogen	56·16	54·18
	100·00	100·00

Deducting the carbonic acid, the residual air has the composition:—

Oxygen	24·74	27·10
Nitrogen	75·26	72·90
	100·00	100·00

a larger proportion of oxygen than is found in common air.

Heating Rooms by the New Cheminées Caloriferes of M. Bolo de Sevray.—The arrangement of these stoves cannot be made intelligible without the aid of diagrams. It is said that of the 4000 calories produced by the combustion of 1 kilogramme of wood, from 200 to 300 at most are utilised in a common fire, the rest escaping without doing any service. The new *Cheminée calorifère* utilises 2500 to 2800 calories.

November 30, 1876.

In an article headed "Anti-Religious Hatred of Free-thinking Science," it is asserted that "Recamier performed 40 years ago, and on a larger scale, a great number of the experiments of Mr. Crookes on the impulsive force of light and heat, and set up in his cabinet a colossal radiometer.

A fresh attack is made on the French physicians and men of science who have agreed to bequeath their bodies for dissection.

New Radiometric Experiments.—M. Collado.—The author has exposed a sensitive radiometer to the light of the full moon, and concentrated the light upon the blackened surfaces of the discs by means of lenses or of concave mirrors, but without perceiving any movement. In like manner, if a radiometer is submitted to the radiation of a single Bunsen burner the speed of the revolution is not altered if the pale blue flame is rendered luminous.

Influence of Different Colours upon Vegetation.—M. Paul Bert.—The author has undertaken some new experiments upon the influence of different colours upon vegetation. These experiments, performed chiefly upon the sensitive plant, lead to the following results:—Green light kills plants; plants submitted to the influence of the green ray die in a short time. Under the influence of the red rays the sprays become elongated; the leaflets are raised so as to form a smaller angle with the branch than in the normal state, the plant appears to become etiolated and yet it remains alive. Under the influence of the blue rays the process is reversed, the leaflets become perpendicular to the branch, whilst in white light an intermediate position is maintained (*i.e.*, the leaflets form with the branch an angle of 45° on one side and of 75° on the other. M. Bert explains these facts as follows:—At the

level of the point of attachment of the leaflet there is a motor enlargement, which increases or lessens in force according to the different kinds of rays. Under the influence of the red rays there is formed in these enlargements a particular substance, osmotic, and capable of attracting water. This substance generally disappears under the influence of the blue rays. If we place it under a glass shade, red on one side, and green on the other, the plant turns its leaflets towards the green, that is to say, towards the colour which kills it, and in fact it dies.

Reimann's Farber Zeitung.
Nos. 40 and 41, 1876.

These issues contain nothing of general interest or importance.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

DECEMBER, 1876.

The following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2-inch Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Hydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Slightly turbid	0·003	0·009	0·165	0·128	20·76	7 670	0·540	0·94	2·130	13·2	3·8
West Middlesex	Slightly turbid	0·006	0·009	0·165	0·100	22·61	8 960	0·540	0·94	2·130	14·3	4·6
Southwark and Vauxhall	Slightly turbid	0·002	0·008	0·150	0·114	21·14	8·120	0 540	0 94	2·060	14·3	4·6
Chelsea	Slightly turbid	0·006	0·010	0·135	0 132	19·18	7·110	0 5·0	0·94	2·400	12·1	4·6
Lambeth	Slightly turbid	0·001	0·007	0·150	0·110	19·48	7 390	0·570	1·01	2·600	12·7	4·6
Other Companies.												
Kent	Clear	0·000	0·002	0·216	0·007	26·73	10·020	1·000	1·37	3·000	19·4	5·1
New River	Clear	0·000	0·004	0·160	0·092	19·28	7·440	1·460	0·86	1 730	14·3	4·2
East London	Slightly turbid	0·002	0·006	0·135	0·152	23·21	9·200	0·610	1·15	2·460	15·4	3·4

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

MEETINGS FOR THE WEEK.

MONDAY, Jan 15th.—London Institution, 5.
— Medical, 8.
TUESDAY, 16th.—Civil Engineers, 8.
— Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
— Zoological, 8.30.
WEDNESDAY, 17th.—Society of Arts, 8.
— Meteorological, 7. Annual General Meeting.
THURSDAY, 18th.—Royal, 8.30.
— Dr. Wright, "On Metals and the Chief Industrial Uses of these Bodies and their Compounds."
— Chemical, 8. "Preliminary Account of some New Reactions in Organic Chemistry and their Utilisation in Dyeing," by C. T. Kingzett and H. W. Hake. "On Kekulé's and Ladenburg's Benzene Symbols," by H. E. Armstrong. "On Nitro-succin," by J. Stenhouse and C. E. Groves.
— London Institution, 7.
— Zoological, 8.
FRIDAY, 19th.—Royal Institution, Weekly Meeting, 8. Professor Tyndall, "A Combat with an Infective Atmosphere."
SATURDAY, 20th.—Royal Institution, 3. Mr. Ernst Pauer, "On the Nature of Music, the Italian, French, and German Schools (with Pianoforte Illustrations).
— Physical, 3. "On the Photographic Spectra of Stars," by W. Huggins, D.C.L., F.R.S. "On the Artificial Production of Columnar Structure," by W. Chandler Roberts, F.R.S.

TO CORRESPONDENTS.

E. F. George.—The specific gravity, hardness, crystalline form, and optical properties will be sufficient to identify most transparent mineral crystals.

F. Faulkner.—Messrs. Asher and Co., of Bedford Street, Covent Garden, can perhaps procure a copy for you.

ROYAL INSTITUTION OF GREAT BRITAIN, ALBEMARLE STREET, PICCADILLY, W.

DR. C. R. ALDER WRIGHT, will, on THURSDAY NEXT, JANUARY 18, at Three o'clock, begin a Course of Four Lectures "On Metals, and the Chief Industrial Uses of these Bodies and their Compounds." Subscription to this Course, Half-a-Guinea: to all the Courses in the Season, Two Guineas.

ROYAL SCHOOL OF MINES.—Dr. FRANKLAND, D.C.L., F.R.S., will commence a Course of Thirty Lectures on "Organic Chemistry," at South Kensington, on MONDAY NEXT, the 15th JANUARY, at 10 o'clock, to be continued on each succeeding Wednesday, Friday, and Monday at the same hour. Fee, £5; to those who have attended the previous Course £2.

TRENHAM REEKS, Registrar.

THE TEXTILE COLOURIST: Edited by CHARLES O'NEILL, F.C.S.

Price 2s. 6d. Monthly.

CONTENTS OF No. XIII.—JANUARY, 1877.

Introduction—Materials for a History of Textile Colouring, No. 4 (continued)—Programme of Prizes offered by the Industrial Society of Mulhouse for the Year 1877—Upon the Greening of Aniline-Black—Koechlin Freres Process for Preventing the Greening of Aniline-Black—M. Camille Koechlin upon the Greening of Aniline-Black—Experiments upon the Application of Anthra-violet, by M. N. Potier—Nitro-alizarin and Amidalizarin—M. Michel de Vinant on Dyeing, Printing, and Bleaching—New Book: A Treatise upon Washing Machines employed in Bleaching and Calico Printing, by Jos. Depierre—Abridgments of Complete Specifications of Patents Recently Published—British and Foreign Patents, from the Commissioners of Patents Journal, October 27th to December 19th, 1876, inclusive—Diagram: Firth's Improvements in Indigo Dyeing—Diagram: Mather's Improvements in Steaming—Supplement: The Practice and Principles of Calico Printing, Bleaching, Dyeing, &c., by Charles O'Neill, F.C.S.—Fixing of Mordants—Dyeing Apparatus (continued).

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THE CHEMICAL NEWS

Vol. XXXV. No. 895.

ON THE GROWTH OF THE ALKALI AND BLEACHING-POWDER MANUFACTURE OF THE GLASGOW DISTRICT.*

By JAMES MACTEAR.

(Continued from p. 17.)

Part III.—Bleaching-Powder.

It was in the year 1785 that Berthollet discovered the bleaching action of chlorine; he showed the experiments to Watt in 1786, and he on his return to Glasgow actually bleached a considerable quantity of linen by means of a solution of chlorine in water.

In the following year a work was established in Aberdeen by Professor Copeland and the then Duke of Gordon, for the production of solution of chlorine, which they supplied to the neighbouring bleachers.

The injurious effects of the chlorine both on the workmen and on the goods caused the introduction of a portion of potash to the water, which had the effect of retaining the chlorine.

This method was extensively adopted by bleachers all over the country; the solution, however, did not keep well.

In 1798, Mr. Charles Tennant (then engaged in bleaching operations at Darnley) patented the use of lime instead of potash, and in conjunction with Mr. M'Intosh and others began the manufacture of "lime bleaching liquor." They also granted licenses to bleachers, giving the right to manufacture it for themselves. The method was most successful, but the patent was disputed and declared untenable.

Mr. Tennant, however, in the following year patented a method of producing a dry compound of lime of chlorine, which, long known as Tennant's bleaching-salt, and more recently as bleaching-powder, has completely revolutionised the process of bleaching.

Works were erected for the manufacture of this article at St. Rollox in the same year.

It was prepared originally by the decomposition of a mixture of salt, manganese, and sulphuric acid, in a leaden still heated by a water-bath, and the chlorine was absorbed by lime (slaked and sifted) in a leaden receiver, the lime being agitated from time to time by means of a stirrer.

The proportions used in the beginning of the year 1800 were:—

Vitriol	4
Manganese	2
Water	4
Salt	4½

These proportions were altered from time to time, and muriates of potash, lime, and magnesia were tried, with a view of obtaining by-products of greater value.

The question of the utilisation of the by-products was one which became very serious indeed as the production increased, and in 1803 the question was solved for the time by the production of an impure soda or black-ash from the still residuums.

As the demands became greater, various methods were adopted to increase the production, and finally the system of stone stills, heated externally by means of steam, was adopted.

In 1823 the use of muriatic acid prepared from salt was employed. At first the process was tried with manganese in a separate vessel, through which passed the muriatic acid driven off from the salt. Very soon this was abandoned for the method now in use of condensing the acid in water, and using it in the liquid state.

The salt was at first decomposed in iron cylinders, and the condensers were cylindrical and of earthenware.

The condensing arrangment of Mr. Gossage was adopted soon after its introduction to the trade, and has been most successful at these works, which, indeed, are laid down with the object of utilising the muriatic acid to the utmost—the loss of muriatic acid being now (1876) under 1 per cent.

Within the last few years there have been erected in the district three works for the production of this article in connection with the alkali manufacture, viz., those of Messrs. Ore and Brown and Henderson, both at Irvine, and Messrs. Arnott Bros., Kirkintilloch.

The method of manufacture devised by Mr. C. T. Dunlop is still a specialty at the St. Rollox Works.

It consists in decomposing a mixture of nitrate of soda and salt with sulphuric acid. This yields a mixture of nitrous acid and chlorine gases, with traces of muriatic acid.

The nitrous acid is separated by absorption in strong sulphuric acid, the muriatic acid by water, while the chlorine passes on to the bleaching-powder chambers to be absorbed by the lime.

An idea of the progress of the bleaching-powder manufacture may be had from the following table:—

Table of Prices Realised.

Year.	Tons.	Price.
1799—1800	52	£140 0 0
1801	96	130 0 0
1802	72	112 0 0
1803	Not known	
1804	131	112 0 0
1805	147	112 0 0
1810	239	93 0 0
1815	377	81 0 0
1820	333	60 0 0
1825	910	27 0 0
1830	1447	25 0 0
1835	2122	22 0 0
1840	2393	26 0 0
1845	3801	16 0 0
1850	5719	14 0 0
1855	6260	11 0 0
1860	7459	11 0 0
1865	8431	10 10 0
1870	9251	8 10 0

Part IV.—Alkali.

The production of alkali has been one of the Glasgow chemical industries since at least 1798.

It seems to have been made at first by furnacing kelp with charcoal and a little quicklime.

A method in use for the production of an impure alkali for soap boilers is described as follows in a note-book dated 1800:—

"*To make the Hepar of Soda or Potass from the "Sulphates.*

"It is necessary to dry these salts in a reverberatory furnace, then mix them with their weight of fir sawdust, and fuse them in a reverberatory furnace; when the surface becomes calm, the operation is complete—let the sulphure run out. If it is a sulphure of potass, break it up with a hammer, dissolve in water, evaporate it, and when the salt begins to form, put in sawdust till it is thick.

"Then put it into the calcining furnace, roast it for an hour, two-thirds of the sulphate will be decomposed, separate the undecomposed part by solution.

"If you operate on the sulphate of soda, after the first sulphure is produced, add more sawdust, melt a second time to a sulphure, then operate as with the potass."

* Read before the Chemical Section of the British Association, Glasgow Meeting, 1876.

The use of the still liquors from the chlorine manufacture early attracted attention.

These consisted chiefly of sulphates of soda and manganese, and were at first worked up into Glauber's salt, and the manganese seems to have been recovered to some slight extent.

In the year 1800 Lord Dundas had a work for the manufacture of mineral alkali in operation at Dalmuir.

The works were of considerable size for that period, as the following table will show, being a statement of the working for years 1801 to 1804:—

View of Mineral Alkali Works.

Year.	Alkali Sold. T. C. Q. Lbs.	Price per Ton.	Black-Ashes Sold. T. C.	Price per Ton.
1801	25 12 2 24	£49·5	112 15	£10·0
1802	62 11 0 21	47·9	31 5	12·2
1803	46 16 1 2	41·2	—	—
1804	128 16 2 6	37·0	—	—
	263 16 2 5	£42·0	144 0	£10·56
Year.	Barilla Sold. T. C. Q. Lbs.	Price per Ton.	Muriate of Potass Sold. T. C.	Price per Ton.
1801	5 0 3 23	£15·0	54 10	£13·00
1802	14 6 0 0	20·2	122 0	13·24
1803	23 17 1 25	20·0	121 10	13·00
1804	21 6 3 0	20·9	90 0	6·50
	64 11 0 20	£20·23	388 0	£10·56

From the fact that soap leys and the salt obtained from them were purchased in large quantity from the soap makers, it is probable that the process was substantially the same as that described as follows, in November, 1806:—

"At Dalmuir they prepared from soap leys got from Paisley and elsewhere, 150 tons salts, and from these 120 tons crystals of soda and 21 tons muriate of potass.

"The manufacture employed 15 workmen, and consumed 1200 tons of coal, at 10s. per ton, delivered at the works, and used 200 barrels potass at 10s.

"Sal-e-nixon (sulphate of potass) and sulphur ashes (chiefly sulphate of potass), from nitre used in the vitriol manufacture.

"When potass is used, it is added to the mother-liquors of the first crystallisation of soda, never put into the furnace with the soap salts.

"When sal-e-nixon or sulphur ashes are used, the first is put into the furnace with the salts, sawdust, and a little quicklime; the second is first lixiviated.

"Their furnace yields 12 cwts. of flux per charge, and requires six hours to flux it. They do two charges in twelve hours, but do not work at night, it being found a preservation of the furnace to allow it to cool during the night.

"The furnace is shut up when the charge is put in, and is never stirred during the operation.

"Soda and muriate of potass are crystallised out alternately.

"The muriate of potass is never raked out over the hot solution of the salts. The carbonate of soda is found to fall with the muriate when the evaporation is continued until the salts begin to form.

"They do not know whether the decomposition of the muriate of soda with the sulphate takes place in the furnace or in the subsequent process of evaporation.

"The mother-liquors are heated with sawdust in order to make them crystallise, that is, to carbonate them.

"The soda is seldom ever crystallised twice, particular attention being paid to having the solution pure.

"The liquors are sometimes filtered.

"The soapers' leys are evaporated in iron vessels, say circular vessels of the usual form, in one piece, and yielding 8 cwts. salts per day. They contain about 500 galls. each.

"The lead coolers are 9 ft. long by 4½ ft. broad, and 10 ins. deep.

"The lead boilers are nearly of the same dimensions, but 15 ins. deep.

"They say they have found a substitute for potass in decomposing the muriate of soda, which works equally well and does not cost 20s. per ton.

"The crystals are seldom ever free from muriate of potass, even when the crystallisation is pretty perfect in form.

"The muriate of potass, on the other hand, is seldom ever free from alkali.

"When the potass is redundant in the liquors, they will not crystallise.

After the muriate of potass is crystallised, the mother-liquor is carbonated, and soda crystallised from it.

"*Charges on One Ton of Soda.*

"1·25 tons soap salts, at £6 10s. ..	£8 2 6
"0·15 " potass, at £60..	9 0 0
" 4 " coals, at 10s.	2 0 0
"40 bags sawdust, at 4d.	0 13 4
"Wages	5 0 0
"Incidents	1 0 0
"Tear and wear	3 0 0
"Interest	2 10 0
	"£31 5 10"
In all	£31 5 10
By 3 cwt. muriate of potass, at 13s.	1 19 0
Nett cost of 1 ton of crystals of soda ..	£29 6 10

Selling price, about £60.

The yearly statement shows the make to have been 120 tons, and the cost £32 per ton.

By another method in use about the same period, a mixture of 10 cwts. of soapers' salts, 6 cwts. of sawdust, and 3 cwts. of lime, was heated for six hours in a furnace until fluxed; it was then run off, and when cold, broken into small pieces and lixiviated in large vessels holding as much as 10 tons at a time, on a filter bottom of gravel and sand placed on coarse canvas. This filter lasted two to three months.

The liquor from this black-ash deposited a considerable quantity of muriate of potass.

The remaining liquor was evaporated slowly without boiling till a pellicle formed, and then run off to crystallise.

To the mother-liquors, from this crystallisation, 3 cwts. or so of potash in solution (according to quality of liquor) is added, the liquid again concentrated and crystallised, this being the third crop of muriate of potash crystals.

The mother-liquor from this was called barilla-liquor; it was boiled down to dryness, the salts mixed with their own weight of sawdust, and carefully roasted till the sawdust was consumed, never being allowed to flux.

Another method of carbonating was to make the salts red-hot, and then mix them as quickly as possible with powdered charcoal.

This carbonated alkali was then lixiviated with cold water, evaporated till a pellicle formed, and after settling for about twelve hours, run into coolers to crystallise.

This soda was re-crystallised.

"In preparing barilla salts for bleachers" (this was actually what is now called soda-ash) "the colour may regulated by the use of nitre—if a white is desired, greater quantity; if a blue, a lesser will suffice.

"A note of the production of soda from kelp show that from—

"100·00 kelp,
" 2·72 charcoal,
" 7·29 potass (crude),
"200·00 coals,

"there should be obtained—

"74·3 soda crystals,
"28·4 muriate of potass,
"33·0 sulphate of potass."

The methods which were adopted at the St. Rollox Works were very various as fresh light was thrown on the science of chemistry.

Almost immediately after the commencement of bleaching-powder manufacture, the waste products of the stills were utilised for the production of alkali for soap making.

These residues, consisting chiefly of sulphate of soda and manganese, with varying quantities of common salt and sulphuric acid in the free state, were in the first case used in the manufacture of Glauber's salts; this was followed by a method of making sal-ammoniac from urine collected in Glasgow in casks.*

This process was found unsuitable, probably from the difficulty of obtaining ammonia in sufficient quantity, and was soon displaced (in 1803) by a process, or rather a sequence of processes, which, with slight variations, continued in use for many years, until the introduction of the complete Leblanc system of alkali making.

This was the production of a crude alkali or black-ash for use in soap making instead of kelp, then usually employed.

The earliest details which I have been able to find show that the still residuums were run into wooden tubs, where they were mixed with ground coal or sawdust till in a thick pasty state: this mass was then transferred to a reverberatory furnace and melted. When the decomposition had ceased it was run out, and when cold, broken up and lixiviated with caustic lime, and the caustic leys thus formed were used in the saponification of the fatty matters.

This was followed by a method of mixing the liquor obtained by lixiviating the above black-ash with sawdust, and again furnacing, when a barilla was obtained worth at that time about £28 per ton.

Cost of One Ton Barilla from Residuum.

6 cwts. salts, at 5s.	£1	10	0
5 „ lime, at 1s.	0	5	0
40 „ coal, 7s. 6d.	0	15	0
Labour	0	6	0
Tear and wear	0	2	0
Yielding 1 ton barilla, costing ..	£2	18	0

And containing 3 to 10 per cent alkali, worth then about £10 per ton.

The soap leys, after having become spent, were boiled down to salts, and barilla again made from them, much on the system already described as in use at Dalmuir.

Cost of One Ton Barilla from Soaper's Salts.

14 cwts. of soapers' salts, at 5s. ..	£3	10	0
3 „ lime, at 1s.	0	3	0
20 „ coal, at 7s. 6d.	0	7	6
Labour	0	4	0
Tear and wear	0	1	4
	£4	5	10
By 10 cwts. of muriate of potash, at 5s.	2	10	0
1 ton of barilla of 7 p.c. alkali, costing	£1	15	10

At first the muriate of potash was employed in the stills instead of common salt, but this was soon given up, and the muriate of potash was sold, chiefly to the alum makers of the district.

The manufacture of vitriol gave as a by-product a considerable quantity of "sulphur ash" residues, consisting of sulphate of potash, mixed with a little unburnt sulphur. This was used along with soapers' salts, and gave a larger yield of muriate of potash.

The mixture employed seems to have been at this time—

280 lbs. soapers' salts.
112 „ sulphur ashes.
84 „ lime.
112 „ coal.
588 „ in all.

Yielding 364 lbs. black-ash, containing 10·5 per cent alkali, and 25 per cent insoluble.

In 1806 a trial was made of the mother-liquors from the alum works as a source of potash; the black-ash made from a mixture of this liquor and soapers' salts gave only about 6 per cent alkali, and from this and other causes its use was soon abandoned.

"A statement of the products obtained at this time from 100 parts of salt is subjoined:—

"100 parts salt,
" 83 „ oil of vitriol,
" 56 „ manganese,

"produced bleaching-powder. The residue from above, with 150 parts American potash of 81 per cent., "produces—

" 265 parts soda crystals.
" 160 „ sulphate of potash.
" 50 „ of manganese recovered.

"It will therefore produce as much soap as 16 cwts. of kelp, even reckoning kelp as containing above 3 per cent of real soda, worth 10s. per cwt."

Methods more or less of this nature continued to be used until about 1816, when a good deal of correspondence with the French manufacturers, Chaptal and D'Arcet, took place, relative to the Leblanc system, which was finally adopted in 1818.

The following extract from the correspondence is of considerable interest, under date July, 1816. Messrs. C. and D'A. say, in reference to their manufacture of soda:—

"They produced 44,000 lbs. per day of crude soda (black-ash), containing 20 to 21 per cent alkali, which they sell at 20 francs per quintal (equal to 16s. 8d.).

"It is produced from common salt obtained from the spontaneous evaporation of the sea-water at Marseilles, and costs about 9d. to 10d. per quintal. It is decomposed by sulphuric acid in the proportion of 83 acid to 100 salt.

"In purifying their crude soda, and crystallising, they always experience a loss of nearly 25 per cent of the alkali, indicated by the acid test in the crude soda."

These gentlemen utilised to some extent the muriatic acid evolved, by producing gelatine from bones, for the manufacture of soup, of which M. D'Arcet says he had made 1,300,000 portions of a quart each.

In 1818 these gentlemen had the intention to "establish works in Liege and in London, for making soda, nitric acid, marine acid, gelatine, &c."

In this year a process was at work at Port-Dundas for preparing a black-ash for soap-making purposes, and this is the first record of the use of carbonate of lime (previously caustic lime seems to have been always used).

The mixture used was:—

10 parts soapers' salts.
2½ „ poor kelp.
2½ „ chalk.
5 „ sawdust.

This was fluxed for six hours, and gave a black-ash testing 6 to 7 per cent alkali.

In the end of this year, French soda was imported into London. It was in the form of black-ash, and of three qualities.

No. 1, containing	13	per cent alkali,	sold at	£30	per ton.
„ 2, „	12	„	„	26	„
„ 3, „	11	„	„	25	„

It was manufactured at Marseilles by the Leblanc process, which had been fully established there for some years. Three qualities of soda were made for sale.

* The obtaining ammonia from urine has been tried at various times in Glasgow, and at present Mr. C. Chapman works a process which is believed to be very successful.

1. Crude soda (now called black-ash).
2. Crystals obtained by the lixiviation of the crude soda.
3. Calcined residues from the "bitter water" (now called soda-ash).

All these qualities had certainly been produced since the year 1807, works being in operation at Marseilles, Chauny, Rouen, Lille, Amiens, and elsewhere.

The first sale of soda made at St. Rollox on the Leblanc system, took place in the end of 1818. It was sold at £42 per ton. Carbonate of soda, or soda-ash, had been made for some months previously, but was apparently all consumed in the manufacture of soap.

The use of soapers' salts was still continued, and black-ash was made for sale from the following mixture:—

1	cwt.	Irish kelp.
1½	,,	soap salts.
1	,,	sulphur ashes.
1½	,,	chalk.
1½	,,	coals.
In all, 6½	,,	

Yielding 3 cwts., 2 qrs., 14 lbs. black-ash, containing 14 per cent alkali.

In the following years soda crystals were sold in constantly increasing qualities.

Table of Prices Realised.

Year.	Price Per Ton.
1818	£42 0 0
1819	41 0 0
1820	40 0 0
1824	27 0 0
1829	15 0 0
1834	12 0 0
1839	11 0 0
1844	6 0 0
1849	5 10 0
1154	4 10 0
1859	6 0 0
1864	4 15 0
1869	4 5 0
1874	5 10 0

The quantity made has rapidly increased from about 100 tons in 1818, to 1400 tons in 1829, and is now nearly 14,000 tons per annum.

Carbonate of potash was made in considerable quantities from about 1820.

It was produced from the sulphate of potash (obtained as a by-product in the manufacture of sulphuric acid) by the Leblanc system. The price in 1820 was £15 per ton. On the introduction of nitrate of soda as a substitute for nitrate of potash, this manufacture was given up at St. Rollox; but it has revived again in the district within the last few years, considerable quantities being now manufactured, chiefly for their own use, by the bichromate and prussiate of potash manufacturers.

Soda-ash, so-called, was first sold from these works in 1833, when it rapidly took the place of black-ash, previously sold. In 1833 only 19 tons of soda-ash were sold, at a price of £22 per ton; in 1865 the quantity had increased to 12,500 tons, sold at £9 per ton.

The sulphate of soda required for the manufacture on the Leblanc system was at first prepared at these works in iron cylinders (such as are yet usually employed in the manufacture of nitric acid), and the muriatic acid evolved was condensed in upright earthenware condensers.

In 1822, pots of some form were introduced, the charge of salt weighing 4½ cwts., and yielding 560 lbs. muriatic acid of 40°.

Various improvements were introduced from time to time; amongst others, Gamble's improved furnace for salt-cake making; Gossage's condensing towers; the circulating system of vats for lixiviating black-ash, first adopted at these works, and introduced by Mr. C. T. Dunlop.

The revolving black-ash furnace of Elliott and Russell was tried at St. Rollox soon after its invention, but failed at that time to give satisfaction, the furnace at that time being too small and imperfect to compete with hand labour at the low rates then paid.

It was much improved by Messrs. Stevenson and Williamson, of the Jarrow Works, both in construction and in the method of working it, and became in their hands quite a success.

This form of furnace was again introduced at the St. Rollox Works, where there are now three furnaces.

These are worked on a system, patented by the writer, which has been eminently successful. It has increased the producing power of the furnaces over 50 per cent, with a large saving of raw material, and a corresponding diminution in the quantity of waste produced. The amount of alkali usually lost in the waste being proportionately reduced.

This system is now employed in a number of the largest alkali works in England, and it is expected will shortly be at work in France.

The form of the furnace has at the same time been much improved; and while the first furnace erected at Jarrow was capable of working somewhere about 8 tons sulphate of soda per twenty-four hours, the most recent of those erected at St. Rollox decomposes 50 tons in the same time.

The three revolving furnaces easily decompose 720 tons sulphate of soda per week of six days.

The most recent improvement introduced is a mechanical furnace for calcining or carbonating the soda-ash. This has only been at work for a short time, but promises to be quite as successful as the black-ash furnaces have been.

Other works in Glasgow and the district have been erected at various times for the manufacture of alkali, of which there are at present existing as alkali works, so far as I can ascertain, only four, viz.:—

Messrs. R. and J. Garroway, Glasgow.
,, Orr and Brown, Irvine.
,, W. Henderson and Co., Irvine.
,, Arnott, Bros., and Co., Kirkintilloch.

To be continued.)

ON SOME BLOWPIPE REACTIONS.*

By E. J. CHAPMAN, Ph.D.,
Professor in University College, Toronto.

(Continued from page 14).

V. *On the Solubility of Bismuth Oxide in Carbonate of Soda before the Blowpipe.*

Neither in the treatise of Berzelius, nor in the more modern and advanced work of Plattner, is any reference made to the behaviour of oxide of bismuth with carbonate of soda in an oxidating flame. In Plattner's "Tabellarische Uebersicht des Verhaltens der Alkalien, Erden, und Metalloxyde für sich und mit Reagentien im Löthrohrfeuer," whilst oxide of lead is stated, correctly, to be soluble in carbonate of soda in an oxidating flame, the reference to oxide of bismuth is, simply, that with carbonate of soda on charcoal it becomes immediately reduced to metallic bismuth; and none of his translators seem to have thought it necessary to supply the omission. In Hartmann's tabular "Untersuchungen mit dem Löthrohr," in the handy little work of Bruno Kerl ("Leitfaden bei qualitativen und quantitativen Löthrohr-Uutersuchungen"), in the "Löthrohr-Tabellen" of Hirschwald, and all other blowpipe books that I have met with, the same singular omission occurs. This seems to bear out very forcibly the somewhat cynical adage that "books are made from books." To supply the omission, it may be observed that

* Communicated by the Author.

bismuth oxide dissolves in carbonate of soda very readily in an oxidating flame if the supporting agent be platinum wire or other non-reducing body. The glass is clear yellow whilst hot, but on cooling it assumes an orange or yellowish brown colour, and becomes pale yellow and opaque when cold. As regards their solubility by fusion in carbonate of soda, metallic oxides fall into three groups—(1) Easily soluble, *e.g.*, PbO, Bi_2O_3, BaO, &c.; (2) Slightly or partially soluble, *e.g.*, Mn_2O_3, CoO, &c.; and (3) Insoluble, *e.g.*, Fe_2O_3, Ce_2O_3, NiO, CuO, MgO, &c.

VI. *On the Detection of Bromine in Blowpipe Experiments.*

When fused with phosphor salt and copper oxide the bromides, it is well known, impart an azure blue colouration to the flame, much like that produced by chlorides under similar treatment, although streaked more or less with green, especially at the commencement of the operation. To distinguish these bodies more closely Berzelius recommended the fusion of the test substance with 6 or 7 volumes of bisulphate of potash in a closed tube. Bromines by this treatment become decomposed, as a rule, and give off strongly-smelling brownish or yellowish red vapours of bromine. But this process does not always give satisfactory results, as in some instances the bromide is very slightly attacked. In this case, the following method, based on a peculiar reaction of bromide of silver, first pointed out by Plattner, may be resorted to. If insoluble the bromide is fused with 2 or 3 volumes of carbonate of soda. A soluble bromide of sodium is thus formed, with separation of the base. To the filtered or decanted solution of the fused mass a small fragment of nitrate of silver is added, in order to precipitate bromide of silver. This, collected by decantation, is fused with a small quantity of bisulphate of potash in a little flask or test-tube. The bromide of silver will quickly separate from the flux in the form of a blood-red globule, which becomes pale yellow when cold. The little globule, washed out of the tube by dissolving the fused bisulphate in some warm water, is carefully dried by being rubbed in a piece of blotting- or filtering-paper, and is then placed in the sunlight. After a short time it will turn green. Chloride of silver, as obtained in a similar manner, melts into an orange-red globule, which changes to clear yellow on cooling, and finally becomes white, or nearly so. Placed in sunlight it rapidly assumes a dark grey colour. Iodide of silver, under similar treatment, forms whilst hot an almost black globule, which becomes amethyst-red during cooling, and dingy yellow when cold. In the sunlight it retains the latter colour. A mixture of chloride and iodide of silver assumes a greenish tint, somewhat resembling the colour acquired by the bromide globule. This, however, can scarcely give rise to any error, as the presence of iodine is revealed—even if no violet coloured fumes be emitted—by the dark amethystine colour of the bead whilst hot.

VII. *On the Detection of Carbonates in Blowpipe Practice*

A mineral substance of non-metallic aspect, in nine cases out of ten, will be either a silicate, sulphate, phosphate, borate, carbonate, fluoride, or chloride; more especially if the streak be uncoloured, or merely exhibit some shade of green or blue, or if the substance evolve no fumes when heated on charcoal.

Simple fusion with phosphor salt on a loop of platinum wire serves at once to distinguish a silicate from any of the other bodies enumerated above, as, whilst the silicate is but slowly attacked, these other bodies are readily and rapidly dissolved. Among the latter, again, the carbonates are distinguished without risk of error by the marked effervescence which they produce in the bead by the evolution of carbonic acid during fusion—the phosphates, sulphates, &c., dissolving quietly. The reaction is quite as distinctive as that produced by the application of an ordinary acid; but, of course, it may arise in both cases not only from a carbonate proper, but from the presence of intermixed calcite or other carbonate in a silicate or other body. It was by its use, upwards of twenty years ago, that the writer detected the presence of carbonate of lime in certain specimens of Wernerite (the "Wilsonite" variety), portions of which had previously been analysed without the impurity having been discovered. It need scarcely be stated that the test substance must be added to the phosphor salt on the platinum loop only after the quiet fusion of the flux into a transparent glass. The reaction is, of course, manifested equally well with borax.

(To be continued.)

ANALYSES OF IRON ORES, LIMESTONES, COALS, &c., USED IN THE IRON MANUFACTURE IN SCOTLAND.

By WILLIAM WALLACE, PH.D., F.R.S.E., F.C.S., Public Analyst for Glasgow, &c.

(Continued from p. 17).

TABLE II.—SCOTTISH CLAYBAND IRONSTONES.

Constituents.	I.	II.	III.	IV.	V.	VI.	VII.
Protoxide of Iron	47·31	39·60	34·98	37·23	32·20	24·90	37·54
Protoxide of Manganese	trace	1·52	0·82	1·96	1·64	1·22	3·60
Lime	0·97	1·79	1·66	5·17	5·74	16·53	6·50
Magnesia	0·91	3·96	2·08	4·17	4·08	7·54	0·43
Carbonic Acid	30·22	30·31	25·46	32·21	29·60	35·61	28·94
Phosphoric Acid	0·49	0·64	0·50	0·45	0·60	1·76	1·92
Sulphur	trace	0·08	0·11	0·25	0·51	0·31	0·27
Iron combined with Sulphur	—	0·07	0·10	0·25	0·45	0·27	0·24
Alumina	7·10	7·03	11·66	5·12	6·55	3·79	6·23
Silica	10·12	11·80	17·80	10·41	14·60	6·80	11·20
Bituminous matter	2·32	1·55	4·17	1·75	2·84	0·73	2·03
Water	0·56	0·75	0·66	0·97	1·19	0·52	1·10
	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Iron	36·80	30·87	27·30	29·21	25·49	19·63	29·44
Specific gravity	3·529	3·395	2·912	3·261	3·126	2·884	3·093
Yield of Calcined Ore, per cent	72·16	70·39	72·28	67·80	68·53	61·77	70·94
Iron in Calcined Ore	51·00	43·84	37·77	43·08	37·19	30·38	41·50
Silica in Calcined Ore	14·03	16·77	24·62	15·40	21·30	10·50	15·77

(To be continued.)

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 4.)

The Sulphur Industry of Sicily.
By Dr. Angelo Barbaglia.

The duration of the process, from the commencement of charging till the last roll of sulphur has been cast, varies with the capacity of the furnace, the nature of the ore, and the condition of the atmosphere. In furnaces of equal size the operation is the more prolonged the denser the ore and the colder the weather. Wind promotes whilst rain retards the combustion. On an average we may assume that the melting requires, for furnaces containing:—

50 to 60 cassas	..	..	..	30 to 35 days
200 „ 250 „	..	..	..	50 „ 60 „
400 „ 500 „	..	..	..	80 „ 90 „

Both in the calcarone and in the calcarella a part of the sulphur is burnt in order to furnish the heat required for the fusion of the rest. The consumption of sulphur for this purpose fluctuates greatly and depends on very various conditions. It is particularly large if the ore is very gypsiferous and contains consequently much water, or if it has been placed in the furnace when moist, or if violent rains have fallen during the burning. In long-continued rains an operation sometimes miscarries entirely. In a successful operation with an ore containing 25 per cent of sulphur, 70 per cent of marly limestone, and 5 of water, theoretically, the combustion of 1-5th of the sulphur should be sufficient, but in practice 1-3rd and even 2-5ths are consumed.

It need scarcely be mentioned that methods have been proposed to obviate this loss, and especially to protect the neighbouring population against the pernicious influence of an atmosphere polluted with sulphurous acid.

At Lercara, where, for a length of time, very rich ores (*talamone*) were exclusively obtained very friable, and, therefore, unsuitable for burning in calcaroni, the fusion has long been conducted in open cast-iron pans, of semi-circular section, heated by means of vegetable fuel. The expense of melting amounted to 2·50 lire per 100 kilos. In each operation 8 to 9 quintals of sulphur were obtained, and 2 to 3 quintals of fuel consumed. The pans served from four to five years. At the sulphur mines of Madora (Province Lecara), where very poor ores have to be worked, this method is not applicable. Durand introduced there the furnace bearing his name. It consists of a quadrangular chamber of masonry, each side measuring 2 metres, with a sloping bottom and a vaulted roof, in the midst of which is an opening for charging and emptying the furnace. In the lower part of the front wall is the tap hole, and on each side is an aperture, the one to kindle the furnace and the other to remove the products of combustion. In such a furnace containing 1½ cassas a fusion (including the time for charging and emptying) lasts twenty four hours. The process is otherwise conducted as in the calcarone.

Another furnace was built in 1861 by Conrad Hirzel, at the Solfara Col di Serio, in the province of Lercara. By means of this apparatus, which was patented by the inventor, the fusion is effected more rapidly, and every loss, whether by sublimation or by combustion of the mineral, is said to be avoided. But this arrangement, though ingenious, is complicated, and the result has generally not come up to expectation, so that after two years the furnace has been abandoned. An apparatus introduced almost simultaneously by Joseph Gill, at the Solfara della Croce (Lercara), which was to effect the fusion of the sulphur by means of hot air deprived of oxygen, as also the system devised by Heinrich Keyser for extracting the sulphur by sublimation in cast-iron or earthen retorts, have met with no better fate. The latter process seems at the best merely serviceable for the treatment of very rich powdered ore (*sterri*) and only for the manufacture of flowers of sulphur.

The proposal of H. Condy Bell (1867) to extract the ores in the moist way with the bisulphide of carbon has not been successful. According to experiments made in 1868 at Bagnoli, near Naples, insurmountable difficulties were met with in the attempt to carry out the process on the large scale.

We must also mention the attempts at extracting the sulphur by means of high-pressure steam. The suggestion was made many years ago by Joseph Gill, but experiments on the large scale were first undertaken by Thomas at Palermo, in 1868. The process has been patented by a company, the *Società privilegiata per la fusione dello solfo, in Italia*.* The process requires the use of ordinary fuel. Steam is used at a tension corresponding to the melting-point of sulphur. Theoretically a pressure of 2 atmospheres should suffice; practically from 3 to 3½ atmospheres are required. A higher pressure would impair the quality of the sulphur.

Not more then 6 or 7 fusions daily can be effected by means of this system, 2 tons being treated each time. In a successful operation not more than 5 per cent of the sulphur originally present remains in the residue, so that an ore of 22 per cent on fusion in steam yields 21 per cent, whilst the process in the calcarone yields merely 15 per cent. This increased production approximately covers the working expenses. Still it must be remembered that Sicily possesses no fuel, and that 60 *lire* is no unusual price for a ton of imported coal. The metal apparatus required is also expensive, not to mention the outlay for the importation of machinery. For the present it must remain undecided whether the steam-fusion process is calculated to supersede the old method. For the treatment of very poor ores the former seems already more advantageous. The company above mentioned have undertaken the fusion of the ores on their own account, taking as payment a percentage of the yield, whilst the rest remains the property of the mine-owner. This percentage varies according to the nature of the ore; at della Croce it is 32 per cent, but in Madore, Montedoro, and Sommatino only 29.

It must not be forgotten that on account of the different nature of the material operated on, the results in different mines vary greatly. Hence in some places where the new process had been introduced it has been again abandoned, whilst in others its retention is still doubtful.

The purification of sulphur is still principally carried on in France, especially in the neighbourhood of Marseilles. In Sicily there are only two or three refineries (at Catania and Porto Empedocle), which only work at intervals and on a small scale.

(To be continued).

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

* Compare also the essay on the utilisation of alkali waste (regeneration of the sulphur), in a subsequent portion of this report.

PROCEEDINGS OF SOCIETIES.

RUSSIAN CHEMICAL SOCIETY.

Julie Lermontoff, *Preparation of Normal Propylyen Bromide* (*Trimethylen Bromide*). Allyl mono-bromide, if saturated at − 10° with HBr, and heated in a sealed tube for a day at 170°, yields almost pure trimethylen bromide. The method is therefore much preferable to that of Reboul and Köser, hitherto used.

O. Miller, *On Iso-dibrom-anthracen*. This compound, $C_6H_4.C_2H_2.C_6H_2.Br_2$, was obtained by the reduction of

dibrom-anthraquinon. It melts at 120°, and is easily oxidised back to the original body.

W. MARKOWNIKOFF, *On the Presence of Aceton in Diabetic Urine.* The author's investigations have led to the detection of large quantities of aceton as well as alcohol in diabetic urine, the origin of which he attributes to the action of a special ferment.

A. SABANEJEFF, *Preparation and Properties of Dibrom-acetylen.* This compound, $C_2H_2Br_2$, was obtained pure by the action of zinc upon an alcoholic solution of tetra-brom-acetylen. It is a mobile liquid, possessing an odour similar to that of chloroform, and boiling at 106°.

A. SABANEJEFF, *Action of Hydrobromic Acid upon Aconitic Acid.* The reaction yields $C_6H_6O_6HBr$, from which an acid, apparently isomeric with citric acid, is obtained by treatment with oxide of silver.

D. PAULOFF, *Action of Monochlorinated Acids upon Zinc Hydrocarbons.* See abstract of papers read before the St. Petersburg Academy (CHEMICAL NEWS, vol. xxxv., page 8).

M. SCHALFEEF, *On Cerotic Acid.* An examination of the supposed cerotic acid, $C_{27}H_{54}O_2$, obtained by Brodie's treatment from bees'-wax, produced in various regions, shows that it is a mixture of several acids. By partial precipitation of the lead salts the author was able to obtain but one pure. This melts at 91°, and corresponds to the formula $C_{34}H_{68}O_2$.

ACADEMIE DE ST. PETERSBURG.

November, 1876.

A. BUTLEROFF, *On Di-iso-butylen.* The author combats vigorously the theory of Schneider that the condensation-products of the olefines are entirely different from the hydrocarbons of the ethylen series, basing his opinions on the following researches:—Trimethyl-carbinol treated with sulphuric acid at 100° yields di-iso-butylen, C_8H_{16}, a colourless mobile liquid boiling at 102·5°. It easily takes up halogens and the hydrogen acids of the halogens. The compound with HI, upon treatment with oxide of silver, gives an acetyl alcohol, solidifying at −20° to a white crystalline mass. The hydrocarbon and its alcohol yield upon oxidation with chromic acid and meta-phosphoric acid identical products—carbonic acid, aceton, acetic acid, trimethyl-acetic acid, a new octyl acid, $C_8H_{16}O_2$, and a keton, $C_7H_{14}O$. From these properties the formula—

$$(CH_3)_2.C.CH.C.(CH_3)_2$$

is assigned to di-isobutylen.

NOTICES OF BOOKS.

The Textile Colourist: a Monthly Journal of Bleaching, Printing, and Dyeing. Edited by C. O'NEILL, F.C.S. (Vol. II.) Manchester: Palmer and Howe. London: Simpkin and Marshall.

THE contents of this volume are correctly indicated by the title. We find papers on the formation of aniline-black, on its analysis, constitution, and tendency to turn green on exposure to reducing agents; on the colours of Croissant and Bretonnière, and on the kindred article known as "Laval catechu;" on the naphthylamin colours; on the new indigo-vat of MM. Schützenberger and Lalande; on the colouring matters from resorcin, &c. These memoirs are chiefly translations or abstracts taken from Continental journals or serials, such as the *Bulletins* of the Industrial Societies of Rouen and Mulhouse, the *Moniteur Scientifique*, &c. There is also a collection of dyeing and printing receipts from a French work by M. de Vinant, and a collection of miscellaneous receipts, concerning which we are told that the editor does not hold himself answerable either for their accuracy or their goodness—a very judicious reservation, since, as we learn, a large part of the public are under the impression that the editor of a scientific or technological journal verifies every process described in his columns.

On the question of the physiological action of the aniline colours, certain experiments are given which would cause them—magenta at least—to be regarded as innocent, if pure, a conclusion which we should be slow to adopt.

In Mr. Jarmain's lectures on wool-dyeing, as delivered before the Society of Arts, the method there described of testing waters for tinctorial purposes by means of a decoction of logwood, whatever its practical value, is not original, having been in print now for several years. The same remark applies to the treatment of the purification of the refuse from woollen mills by running all into a common reservoir. Mr. Jarmain's words, as quoted by Mr. O'Neill, would lead the reader to believe that this was an original observation.

An appendix to the volume contains a systematic treatise on dyeing and printing. The portion of this memoir relating to thickenings must be pronounced able and judicious. That on mordants is much less satisfactory.

Some typographical errors of a puzzling nature occur in the volume. Thus a "dichröic" substance is spoken of as "dichloric," and the locality of the new dye-ware "Lucee" is given as "Guyan,"—probably Cayenne.

A Systematic Handbook of Volumetric Analysis, or the Quantitative Estimation of Chemical Substances by Measure, applied to Liquids, Solids, and Gases. By FRANCIS SUTTON, F.C.S. (Third Edition.) London: J. and A. Churchill.

THOSE who are familiar only with Mr. Sutton's "Handbook" as it first appeared will scarcely be able to recognise it in its present form. In bulk it has been at least doubled, a considerable part of the increase being due to certain sections on the analysis of potable water and sewage, contributed by Mr. W. Thorp. This "monograph on the analysis of waters" Mr. Sutton pronounces a "special feature," and expresses the belief that it "will be found well worthy the attention of all chemists." On this question we offer no remarks, being well aware, as we have declared elsewhere, that nothing finds its true level more certainly than an analytical process. There is also a section on the volumetric estimation of gases.

The main part of the work is enriched with methods for the determination of tannin, which the author admits are not of the most satisfactory character. For the valuation of indigo the methods of McKinlay (bichromate of potash with oxalic acid) and of Ullgren (red prussiate) are given. Cochineal and lac-dye are not mentioned. Volumetric methods are given for the determination of cobalt and nickel, as proposed by Künzel and Winckler. The application of these processes, however, is somewhat limited. A method for bismuth is given. For the analysis of chrome-iron we find, in addition to the method given in the first edition, one by Britton. The section on copper has been considerably enlarged, the process of Steinbeck having been given, but not that of Luckow.

Upon the whole it can scarcely be said that volumetric analysis has made latterly such progress as might have been anticipated.

*Hofmann's Polarimeter, and its Use as a Saccharimeter and Diabetometer.** By H. SOUCLIER. Paris: A l'Institut d'Optique du Docteur J. G. Hofmann.

THIS pamphlet consists of a description of Hofmann's polarimeter and its use in saccharimetry. It would be impossible for us to describe the construction of the instrument in an intelligible manner without the aid of the accompanying illustrations.

* Le Polarimetre Hofmann a franges son emploi comme Saccharimétre et Diabétométre.

Brief General Introduction to the Aromatic Nitro Compounds.[*] By P. Townsend Austen. Leipzig and Heidelberg: Winter.

The author of this pamphlet has undertaken to give a view of the most important facts relating to the nitro-compounds. Want of space has compelled him to omit certain points, such as the physiological action and the practical applications of the nitro-compounds, the relative position of the nitro-group in the molecule, &c. He discusses in succession the constitution and influence of the nitro-group; the preparation of the nitro-compounds; their reduction to azoxy-, azo-, and amido-compounds; the use of different reducing agents, such as ammonium sulphide, zinc, iron, and tin along with an acid, hydriodic acid, &c.; the general reactions of the nitro-compounds, their decomposition by reduction, the direct substitution of the nitro-group by chlorine, &c.; the replacement of the nitro-group by the carboxyl-group, the transformation of the amido-group into the hydroxyl-group; the action of potassium cyanide upon the nitro-phenols; the compounds of the hydrocarbons with picric acid; the abscission of water on the reduction of certain nitro-acetamides; the oxidation of the nitro-compounds, and their behaviour with alkalies, ammonium sulphite, and sulphuric acid. The literature of the subject has been very carefully digested, and the reader finds continual references to the original memoirs.

The History of Copper Extraction by the Wet Way. By William Henderson. Glasgow: W. Macrone.

This essay, "taken as read" before the British Association at its last meeting, consists merely of a discussion of the claims of various persons to the invention of the process in question. We merely note the interesting fact that the Alderley Edge copper mines, though producing an ore which by the Cornish assay yield nothing at all, have paid dividends to the extent of nearly £40,000.

CORRESPONDENCE.

PLASTER HARDENING AND THE GERMAN GOVERNMENT.

To the Editor of the Chemical News.

Sir,—More than twelve months ago a reward was offered for the best means of hardening plaster-of-Paris so as to enable objects cast from it to stand weathering, and allow of their being washed, &c., without injury to fine lines of projection. The advertisement seemed to bear the stamp of official authority, and doubtless many, like myself, were induced to make experiments and to send specimens to the address given. Has anyone who did this heard, or does anybody also know, anything further of the matter, or was the whole affair a hoax, or an attempt to get what was required for nothing? I shall feel grateful for information on the subject.—I am, &c.,

J. L. D.

January 9, 1877.

MILK ANALYSIS.

To the Editor of the Chemical News.

Sir,—I send herewith the results obtained on analysing samples of milk given by ordinary Jamaica cows and goats, as possibly they may be of interest to chemists interested in the milk question. Each sample was supplied by a friend to whom I had given directions respecting the manner of taking it, which I have every reason to believe were carefully followed, and that, therefore, the results given below may be relied on as truly representing the average composition of the milk yielded by the various animals at one milking.

The total solids were determined by drying 5 c.c. on the steam bath for three hours in a platinum dish, and the ash by igniting the dry residue.

The fat was determined by evaporating 10 c.c. in a porcelain basin on the steam bath for about an hour, by which time, if the milk has been frequently stirred so as to break the films which form, no visible moisture will remain, but the residue will not be hard and brittle; it is now detached from the basin by means of a small steel spatula cut down to a blade of about two inches long and properly rounded and sharpened. With this instrument the milk residue is readily removed, and cut up sufficiently small to be easily transferred to a glass bulb of the form of the annexed figure, and of a capacity of from 20 to 30 c.c., the capillary end of which has been first fused, and the expanded portion immediately below the bulb packed with fine cotton-wool. The spatula, stirring-rod,

Bulb for extracting fat from evaporated milk residue.

Cotton-Wool.

Capillary point which can be renewed by drawing out the larger portion immediately above it.

and basin are now well washed with dry ether, which, if poured into the bulb, its mouth closed with a cork and allowed to stand till next morning, when the capillary point is broken off and the ether solution of butter allowed to run into a tared basin standing over warm water, grasping the bulb in the hand will cause the last drop of the solution to be discharged. Fresh ether is now poured into the bulb and allowed to run through; this is repeated three times, when all the butter will be extracted; the residue is turned out of the bulb, the cork replaced, and the capillary end fused, and the bulb put by ready for the next determination. The basin containing the butter is heated for a short time on the steam bath, cooled, and weighed.

I find this a very convenient and accurate method of finding the quantity of fat; the results rarely disagree more than a few hundredths of a per cent. In colder climates it may be practicable to apply the ether to the residue in the porcelain dish, but here I find I cannot work with ether in open vessels. The cotton-wool entirely prevents any solid particles from falling into the tared basin, and by the repeated washings is left free from fat and ready for another analysis.

The tube at *a* is about 1·5 centimetres in diameter and that at *b* about 2 millimetres.

[*] Kurtze Allgemeine Einleitung zu den Aromatischen Nitro Compounds.

	Parts by weight in 100 c.c.			
	Total Solids.	Fat.	Ash.	Solids not Fat.
At one milking :-				
Milk given by 5 cows ..	13·60	3·31	0·72	10·26
,, ,, 4 ,, ..	13·88	3·[illegible]	0·73	9·88
5 quarts from 1 cow ..	12·67	2·20	0·81	10·71
5 ,, ,, ..	12·68	2·73	0·71	9·95
5 ,, ,, ..	13·83	4·07	0·76	9·86
5 ,, ,, ..	14·68	4·55	0·73	10·13
4 ,, ,, ..	11·77	1·52	0·71	10·25
4 ,, ,, ..	13·12	3·20	0·73	9·92
Goats' milk	18·39	7·68	0·89	10·71
Do.	17·44	7·12	0·68	10·32
Do.	18·33	8·24	0·74	10·09
Do.	18·51	7·89	0·80	10·62

(Each sample was from different animals.)

--I am, &c.,

JAMES JOHN BOWRLY.

Kingston, Jamaica, November 9, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 26, December 27, 1876.

Analysis of Pyrogenous Gases.—M. Berthelot.—Reserved for insertion in full.

Certain Derivatives of Dialdol.—M. A. Wurtz.—These are dialdane, $C_8H_{14}O_3$, and dialdanic acid, $C_8H_{14}O_4$. The author has described several of the salts of the latter.

Researches on the Coefficient of Capillary Efflux.—M. A. Guerout.—In the ethers the decrease of the coefficients in proportion as the carbon increases is maintained in a perfect manner. The coefficient of the capillary efflux of the ethers is much higher than that of the alcohols or the acids from which they take their rise; that is to say, the introduction of an organic radical into the molecule of an alcohol strikingly increases the fluidity of the compound.

Practical Study on Gluten, and on its Determination in the Dry State.—A. Lailler.—The author insists that the determination of gluten in the dry state is the only practimeans of arriving at an exact valuation of grain, flour, &c.

New Globular Condition of Quartz Entirely Crystallised.—M. A. Michel Levy.—The author has found in a specimen of porphyry from Morvan a new globular condition of quartz, which seems to him to fill up the interval between crystalline quartz with exterior polyhedric surfaces and chalcedony, which Des Cloiseaux defines as an intimate mechanical mixture of amorphous and crystalline quartz.

Moniteur Scientifique, du Dr. Quesneville, December, 1876.

Memoir on the Preparation of Dextrin-Maltose.—W. G. Valentin.

Action of the Extract of Malt upon Starch.—C. O'Sullivan.—These two papers are derived from English sources.

Analytical Function of the Liver.—Dr. Quinquand.—The liver, if left to itself, gives rise to the same products which exist when it is destroyed in acute yellow atrophy. The chemical process is a splitting up of the albuminoid and collagenous bodies.

Compass with Circular Magnets of M. Emile Duchemin.—This paper consists chiefly of testimonials sent by captains of vessels as to the practical value of the new compass.

Determination of Nitric Acid in Organic Substances, and Chemical Composition of Various Gun-Cottons.—MM. P. Champion and Pellet.—Already noticed.

Colouration of Wines with Artificial Dyes derived from Coal.—M. C. Girard.—For the detection of magenta in red wines preference is given to the method with baryta and amylic alcohol. It is considered that the use of wines so sophisticated may injure health.

Glycero-phosphoric Acid and its Salts.—J. L. Thudichum and C. T. Kingzett.

Certain Reactions of Biliverdin.—J. L. Thudichum.

Action of Alcohol on the Brain.—C. T. Kingzett.

Alkaloid Extracted from Jaborandi.—C. T. Kingzett.—These four papers are from English sources.

January, 1877.

Detection of Rosolic Acid in Presence of Magenta.—MM. Guyot and Bidaux.—Already noticed.

New Researches on the Action of Non-arsenical Magenta introduced into the Stomach and the Blood.—MM. Feltz and Ritter.—Magenta introduced into the stomach invariably produced albuminuria, and when injected into the blood lesions of the cortical substance of the kidneys, and in one case well marked symptoms of dropsy, were observed.

Processes for the Detection of Magenta in Wines.—M. Fordos.—Already noticed.

Determination of Saccharine Matters by means of Standard Solutions.—M. E. Perrot.—Already noticed.

Procedure of MM. Kœchlin Frères to avoid the Greening of Aniline-Blacks.—Aniline-blacks, if submitted to acid reducing agents—such as sulphurous acid and sulphuretted hydrogen—take a greenish colour, due to their more or less complete conversion into emeraldin, which is deep blue in an alkaline state, but is rendered green by the slightest traces of acid. There is a product more highly oxidised than aniline-black, which is no longer transformed into emeraldin by reducing agents, whether acid or alkaline, and which is obtained as follows:—Aniline-black, printed and fixed, is finished as usual, and then submitted in a beck to an acid oxidation at a temperature above 75°. It is then merely required to soap, or simply to wash the pieces. Among the oxidisers which give the best results are the salts of ferric oxide, chromic acid, certain chlorates easily decomposed, such as the chlorate of alumina. The ferric solution is prepared from a per-salt of iron, mixed with 1 to 1½ times its weight of sulphuric acid at 66° B., to prevent the iron from being fixed upon the fibre. This solution is employed in the proportion of 1 to 2 grms. per litre, say 1 to 2 litres to a dye-beck for six to eight pieces, which are passed through it from half an hour to an hour at 80°. As the ferric salts are less generally met with in trade than the ferrous salts, a solution may be prepared as follows:—Ferrous sulphate, 20 kilos., dissolved in 60 to 70 litres of water. To this are added 5 kilos. bichromate of potash, dissolved in 15 to 18 litres sulphuric acid at 66° B. From 4 to 8 litres of this liquor are taken and applied as above. For black and orange styles chromic acid is employed in the proportion of 300 to 400 grms. to a beck for six to eight pieces, or 300 to 400 grms. bichromate and ¼ litre sulphuric acid, proceeding as with the iron. The orange is then raised with an alkaline chromate. For black and fast blue styles a slight excess of ferrous salt must be left in the liquor, as chromic acid would destroy the blue. the formula given above 4 kilos. of bichromate are used n place of 5.

Greening of Aniline-Blacks.—M. Camille Kœchli

—To avoid the "greening" of aniline blacks was a problem laid before chemists. They were not ignorant of a process which gives a black incapable of turning green. In it the metallic salt of Lightfoot—copper or vanadium—is replaced by a ferricyanide. This substitution, brought into practice by M. H. Cordillot, in the firm of Schwartz-Huguenin, a short time after the discovery of the black, merely requires, in order to attain the required solidity, and not to turn green, merely to be sufficiently steamed after ageing. This aniline-black does not attack the doctors, it weakens the fibre less than any other, and it bears steaming; but being dearer, and not keeping so well when mixed, it was unfortunately neglected at a time when the question of "greening" had not been raised. We have, as a further instance, the black iron-lakes of aniline; the aniline-greys obtained by direct fixation with a concentrated and boiling solution of chromate of potash, as well as the naphthylamin-garnets obtained by the same process, colours which remain unaffected by atmospheric reducers. Lastly, we must bear in mind the practice of certain English printers, who steep in chloride of lime between aëration and washing. The exceptional property of the ferricyanide-black suggested the idea of trying the action of ferricyanides upon ordinary blacks already fixed upon cloth. Under the action of alkalies, which have so powerful an influence upon organic substances, the ferricyanides merely behave like the hypochlorites; the black is reddened without being rendered incapable of turning green. It is not the same with hydro-ferricyanic acid. The reaction becomes identical with that of the steamed ferricyanide colour, and the blacks resulting have lost all sensibility to sulphurous acid. M. Jeannaire, who invented this process, did not succeed in utilising it on account of the blue colour which it deposits upon the cloth. He had recourse to another ferric compound, the acid nitrate. In it the blacks acquire the wished-for solidity, and those even which had turned green are rendered incapable of "greening." Aniline-black as developed by mere ageing is therefore a black of incomplete composition. This fact being established, the methods were no longer restricted to ferric nitrate. Other chemists added chromic acid, concentrated chromates (before washing), chloro-chlorate of alumina; procedures which find an application according as the black is accompanied by catechu, or by chrome-yellow, or by madder-red, &c. When the process of Kœchlin Brothers began to be talked of, MM. Depuis and Durand simultaneously added to it nitrites. These compounds required a lower temperature, and were without effect on the colours. These advantages induced MM. Durand and Huguenin, of Bâle, to offer a product of their manufacture, sulpho-azotic acid, a compound which M. Guinon, of Lyons, has employed for forty years in the fixation of catechus. On becoming incapable of turning green the black attains its greatest beauty, the maximum of oxidation coinciding with the maximum of colouration. It loses its violet tone, a loss which might degenerate into impoverishment if the black is not sufficiently intense, or if the fixing liquor is too strong. It should always be added by small quantities, especially in presence of indigo.

The Conception and Mode of Representation of Benzolic Nuclei in Rational Formulæ.—M. Méhay.—Not adapted for abstraction.

Certain New Salts of Bismuth, and their Use in the Detection of Potassa.—M. A. Carnot.—Already noticed.

New Process for the Detection and Determination of Potassa.—M. A. Carnot.—Already noticed.

Determination of the Alkaloids in the Cinchona Barks.—M. J. C. Bernelot Moens.—Not capable of abstraction.

The remaining papers, viz.—"Monobromated and Dibromated Camphor," by J. Montgolfier; "Colouring Matter of Blood," by A. Béchamp; "Certain Purple Colours derived from Cyanogen," by Gaston Bong; and "Researches on the Carbon of White Iron," by MM. Schützenberger and A. Bourgeois, have been already noticed.

Justus Liebig's Annalen der Chemie,
Band 183, Heft 2 and 3.

Studies on the Anthraquinon Group.—Carl Liebermann.

Studies on the Naphthalin Group.—Carl Liebermann.—Two very valuable papers, but quite incapable of useful abridgment.

Communications from the Laboratory of the University of Halle.—These communications consist of a paper on dehydro-triacetonamin: on the sixth aceton base; on the alcoholic bases arising by hydrogenisation of di- and triacetonamin; and on a new platinum salt containing two distinct ammonia bases, all by W. Heintz.

Communications from the University of Erlangen.—These include a paper on ostruthin, by E. von Gorup-Besanez; and one on melyssic alcohol and certain of its transformation products, by L. von Pieverling.

On Pyrosmalith.—E. Ludwig.—The author gives the composition of this mineral as—

Silicic acid	34·66
Ferrous oxide	27·05
Manganous oxide	25·60
Lime	0·52
Magnesia	0·93
Water	8·31
Chlorine	4·88
	101·95

Or, deducting the amount of oxygen equivalent to the chlorine, 1·10, making a total of 100·85.

Preparation of the Earthy Metals in the Chemical Works of Dr. Schuchardt, at Görlitz.—E. Frey.—Calcium, strontium, lithium, and cerium are prepared in quantity in this establishment by Bunsen's electrolytic process. A current of 60° is found more serviceable than one of 90°, as originally recommended by Bunsen. Calcium is not of a brassy yellow, but exactly resembles aluminium in appearance. It is brittle, and cannot be laminated or drawn out to wire. Strontium is a pale brassy-yellow metal, very pliable, and capable of being rolled and drawn, but it oxidises more readily than calcium. Barium has not yet been obtained by this process in a compact state, owing to its elevated melting-point, which appears to be higher than that of cast-iron. From the amalgam the metal was obtained not in a fused, but in a fritted state, in masses exceeding 100 grms. in weight. This was effected by distilling off the mercury in a wrought-iron retort, fitted with a ground lid, into which two iron tubes were screwed. The retort, coated with clay, was exposed to the most intense heat, whilst a continuous current of dry hydrogen was passed through it. Small globules of lithium were fused in an iron capsule to masses of nearly 2 grms. in weight. Cerium prepared by the electrolytic process has all the properties described by Wœhler in 1867. It is particularly distinguished by its brilliant and explosive combustion.

Band 184, Heft 1 and 2.

Action of Phosphorus Pentachloride upon the Amides of Acids.—O. Wallach.—In this paper is examined, first, the action of the pentachloride upon ordinary amides of acids; secondly, upon the substituted amides of the oxalic acid series, diethyloxamid, dimethyloxamid, ethyl- and methyl-oxamethan, and the behaviour of methyl-ethyl-oxamid; and, lastly, the action of the pentachloride upon the substituted amides of monobasic acids.

Constituents of the Cumol of Coal-Tar, and on their Separation.—Oscar Jacobsen.—A lengthy paper, not capable of useful abstraction.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

History of Chemistry.—I would feel very much obliged if any of your numerous subscribers would kindly inform me as to where I could read a good account of the early history of chemistry, such as the science was about 80 years ago.—ENQUIRER.

MEETINGS FOR THE WEEK.

MONDAY, Jan 22nd.—London Institution, 5.
—— Medical, 8.
—— Royal Geographical, 8.30.
TUESDAY, 23rd.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Anthropological Institute, 8
—— Society of Arts, 8. (African Section). "The Trade of Central Africa, Present and Future," by Commander Cameron, R.N., C.B.
WEDNESDAY, 24th.—Society of Arts, 8. "Silkworm Grain," by B. Francis Cobb.
—— Geological, 8.
THURSDAY, 25th.—Royal, 8.30.
—— Royal Institution, 3. Dr. Wright, "On Metals and the Chief Industrial Uses of these Bodies and their Compounds."
—— Philosophical Club, 6.30.
FRIDAY, 26th.—Royal Institution. Weekly Meeting, 8. Sir John Lubbock, Bart., "On Ants," 9.
—— Quekett Club, 8.
SATURDAY, 20th.—Royal Institution, 3. Mr. Ernst. Pauer, "On the Nature of Music: the Italian, French, and German Schools (with Pianoforte Illustrations).

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THE CHEMICAL NEWS

Vol. XXXV. No. 896.

DINITROSO-ORCIN AND DINITRO-ORCIN.*

By J. STENHOUSE and C. E. GROVES.

Although numerous nitro-derivatives, both of hydrocarbons and of alcohols, have been prepared and examined, the nitroso-derivatives, or those which contain the NO group in place of hydrogen, were almost unknown until within a recent period, and even now the number of those which have been investigated is very small.

Dinitroso-Orcin.—It seemed probable that as Fitz had succeeded in preparing dinitroso-resorcin by the action of potassic nitrite and acetic acid on resorcin in aqueous solution, a corresponding derivative of orcin might be obtained by a similar method; and, in fact, it was found that under these circumstances a substance was formed having properties closely resembling those of dinitroso-resorcin, leaving no doubt as to the nature of the new compound. The quantity obtained in this way, however, being but small, and the product far from pure, an attempt was made to prepare it by passing nitrous anhydride into a solution of orcin: the liquid became deep yellow, and on standing some time deposited nitroso-orcin as a brown powder. It was found, however, that it could be far more conveniently prepared by adding the requisite quantity of lead-chamber crystals or nitrosyl sulphate,—

$$\left.\begin{matrix}NO\\H\end{matrix}\right\}SO_4,$$

dissolved in concentrated sulphuric acid, to a dilute aqueous solution of orcin, the amount of nitrosyl sulphate employed being slightly in excess of that represented by the equation—

$$C_7H_6(OH)_2 + 2\left.\begin{matrix}NO\\H\end{matrix}\right\}SO_4 = C_7H_4(NO)_2(OH)_2 + 2H_2SO_4.$$

As it is necessary to avoid as far as possible any admixture of nitric acid, care must be taken in the preparation of the nitrosyl sulphate. The method found to answer best consisted in passing the product of the action of nitric acid of specific gravity of 1·3 on arsenious anhydride at 70° C. into concentrated sulphuric acid.

Very shortly after adding the nitrosyl sulphate the dinitroso-orcin begins to make its appearance as a pale yellowish brown powder, which, after the mixture has been allowed to stand for eighteen to twenty-four hours, may be collected, washed thoroughly, and dried at a gentle heat. As this compound is comparatively insoluble in most solvents it is necessary to convert it into the ammonium compound in order to purify it. This is done by suspending it in about ten times its weight of alcohol, and carefully adding alcoholic ammonia in small quantities at a time until the brown powder is entirely converted into the green crystalline ammonium salt, finally adding a slight excess of the ammonia. After ten or fifteen minutes the green salt is collected, pressed, suspended in water, and decomposed by dilute sulphuric acid. A second treatment of the product with alcoholic ammonia suffices to render it pure.

Pure dinitroso-orcin, $C_7H_4(NO)_2(OH)_2 + 2OH_2$, is a pale coloured crystalline powder, which is almost insoluble in water, alcohol, ether, benzene, &c. It dissolves on being boiled with alcohol for some time, but is decomposed. Heated in a narrow tube it begins to become dark rapidly at 110°, but without fusion, and at 140° C. is almost black. Heated rapidly on platinum foil it fuses and decomposes, but without decomposition. The potassium, sodium, and ammonium derivatives of dinitroso-orcin are green crystalline compounds, but the salts of the alkaline earths and heavy metals are brown amorphous precipitates.

Dinitro-Orcin, $C_7H_4(NO_2)_2(OH)_2$.—Strong nitric acid acts readily on nitroso-orcin, especially when heated, forming trinitro-orcin, together with some oxalic acid. With dilute nitric acid in the cold, however, the action is different; the nitroso-orcin becomes red, and after standing twenty-four hours is converted into an orange-coloured crystalline powder, consisting chiefly of dinitro-orcin. This is purified by crystallisation from ether and from alcohol. Dinitro-orcin crystallises in deep yellow rhomboidal plates, which melt at 164·5°, and with care may be sublimed at a higher temperature. Heated rapidly on platinum foil it deflagrates. Dinitro-orcin is very soluble in ether, and moderately soluble in cold alcohol, but almost insoluble in cold water, carbon bisulphide, and petroleum. Heated with concentrated nitric acid it is converted into trinitro-orcin, $C_7H_3(NO_2)_3(OH)_2$.

The derivatives of dinitro-orcin containing the alkali metals or ammonium are very soluble in water, and difficult to obtain in the crystalline state. With barium it forms two compounds, one of which, obtained when excess of baryta is employed, is almost insoluble in water, and of a deep crimson colour; the other, which has the composition $[C_7H_4(NO_2)_2OH]_2BaO_2 + OH_2$, is slightly soluble in boiling water, but crystallises out almost completely on cooling in long silky needles of a brilliant orange colour.

The authors find that nitrosyl sulphate may be employed advantageously in the preparation of nitroso-phenol, nitroso-thymol, nitroso-naphthol, and dinitro-resorcin, the yield in the case of the last-mentioned substance exceeding 96 per cent of the theoretical amount, whilst Fitz, by the employment of potassic nitrite and acetic acid obtained only 80 per cent.

* Abstract of Paper read before the Chemical Society, Jan. 18.

ON THE GROWTH OF THE ALKALI AND BLEACHING-POWDER MANUFACTURE OF THE GLASGOW DISTRICT.*

By JAMES MACTEAR.

(Concluded from p. 25.)

Part V.—Caustic Soda.

The production of caustic soda was begun at the St. Rollox Works as far back as 1844, by means of a process introduced by a Mr. Weisenfeldt. It was made from the red liquors fused with nitre, and was perfectly white; but there being little or no demand for the article, the manufacture was for the time given up.

The manufacture was again resumed about fifteen months ago, and the various qualities and strengths of—

Cream or unfused	60	per cent
White or fused	60	,,
Do.	70 to 72	,,
White, double refined ..	74 to 76	,,

are now manufactured.

Part VI.—Manganese Recovery.

The recovery or regeneration of the manganese contained in the residuum from the bleaching-powder manufacture was the object of constant investigation. Various methods were tried with but little success; amongst others, those of Binks and of Gossage.

The process still worked at St. Rollox is one invented by Mr. C. T. Dunlop, in 1855, in which the acid still liquors are first neutralised with chalk, and the settled liquor is decomposed under pressure by milk of chalk; the carbonate of manganese thus obtained is washed, dried, and submitted to a heat of about 600° F. for 48 hours, when it gives a black oxide of manganese of high strength.

A description of the process is given in most modern works on technical chemistry.

* Read before the Chemical Section of the British Association Glasgow Meeting, 1876.

This method of recovering manganese is not in use at any other chemical works, the method now universally adopted being that invented by Mr. W. Weldon, which has been adopted by Messrs. C. Tennant and Co., at their works at Hebburn, near Newcastle-on-Tyne, in preference to extending the Dunlop process to that establishment.

Mr. Weldon's process is used, I understand, by all the other makers of bleaching-powder in Scotland.

Part VII.—SULPHUR RECOVERY.

The position of the St. Rollox Works, and the enormous deposits of alkali waste which have accumulated during the long period of their existence as alkali works, caused the question of the recovery of the sulphur from the waste, or from the drainage liquor from the heaps, to become a very serious one. These drainage liquors at one time flowed into a stream called the Pinkston Burn, and from thence found their way into the Kelvin, and ultimately into the Clyde.

Many processes were devised and tried to keep down this flow of drainage, and a very large sum was spent in driving a series of galleries deep down in the rock under the waste heaps, to try, if possible, and intercept a number of springs of water, which, rising under the heaps, dissolved and carried away the soluble sulphur compounds of the waste.

It was not till the beginning of 1868 that a process was at work in a way that might be called successful. It was one adapted by Mr. Ludwig Mond, and consisted in oxidising the fresh exhausted waste while still in the vats by blowing air through, and then using the liquor draining from the heaps instead of water to dissolve out the sulphur compounds.

This process was worked for some years, but had two defects. There was a considerable amount of sulphuretted hydrogen given off in the process of oxidising, and it was not found possible to utilise by this process all the drainage, which was produced in large quantity.

It was superseded in 1871 by a process invented by the writer, which has been very successful, reducing the nuisance arising from these liquors to a very small amount. There is now absolutely no drainage flowing into the Kelvin; and only in such exceptional cases as that of excessive rainfall, diluting the liquor in the natural reservoir in which it is collected to a point at which it could not be worked to advantage, is any run into the Clyde.

The process is being gradually improved; and it is hoped that before long absolutely no drainage of this liquor shall find its way into the river.

I am happy to say that the recovery of sulphur from these liquors, at first undertaken in order to abate a nuisance at no matter what cost, and which was not expected to yield a profit, has now proved a fairly remunerative branch of manufacture.

ON SOME BLOWPIPE REACTIONS.*

By E. J. CHAPMAN, Ph.D.,
Professor in University College, Toronto.

(Concluded from page 27).

VIII.—*On the Uselessness of Turner's Flux as Applied to the Detection of Boracic Acid.*

MANY years ago—about 1827 or 1828—Turner proposed, in examining a body for the presence of boracic acid, to mix the test-substance with bisulphate of potash and fluor-spar (in the proportions of 4½ parts of the former to 1 part of the latter), and to expose the mixture on a clean platinum wire to the point of the blowpipe flame. Fluoboric acid is thus produced; and by its volatilisation, a momentary green colour is imparted to the edge of the flame. Merlet recommends the employment of 3 or 4 parts of this flux to 1 part of the substance under examination. This test is much quoted in blowpipe books and works on chemical analysis generally; but it is altogether superfluous. With borate of soda it fails entirely, or yields very unsatisfactory results; and although it answers for most other borates and for boro-silicates, it is uselessly applied to them, because these bodies colour the flame equally well, *per se*. Berzelius seems strangely to have overlooked the colouration of the flame as produced by many substances under blowpipe treatment. In his work on the blowpipe, for example, he fails to notice the character in describing the reactions of lepidolite, sulphate of baryta, datolite, triphylline, and other minerals, which exhibit it most distinctly. Under axinite, moreover, he has the following statement:—"Turner asserts that a flame tinged green by boracic acid is obtained by the aid of sulphate of ammonia (or bisulphate of potash) and fluor-spar." This "assertion" is true enough; but *all specimens of axinite colour the flame green, per se*. The uselessness of the flux was pointed out, I find, by Buzengeiger as long ago as 1829. In the *Annales des Mines* for that year (tome v., p. 36), he states: "J'ai essayé, pour reconnaître la présence de l'acide borique, d'employer le flux indiqué par M. Turner, mais ces tentatives ne m'ont pas réussi, probablement par défaut d'habitude. Quoi qui en soit, tous les mineraux que M. Turner a vu colorer la flamme en vert en les melant avec son flux, m'ont donné la meme réaction en les introduisant avec quelque soin dans la flamme bleue, sans les mélanger avec aucun réactif." Buzengeiger, whose name does not seem to be quoted in any blowpipe work, appears to have first proposed the sloping blowpipe wick, long before it was adopted by Plattner; and he noticed, at the same early date, that the crimson colouration of the strontium flame was entirely obliterated by the presence of barytic compounds.

IX.—*On the Comportment of Certain Alloys under the Action of the Blowpipe.*

In examining these reactions, about equal portions of the metals (forming the alloy) may be placed together, on charcoal, and subjected to the action of a reducing flame.

1. *Platinum and Tin* unite with violent deflagration and emission of light, forming a hard, brittle, and infusible globule.

2. *Platinum, Zinc, and Tin* unite with violent action, the zinc throwing off long flakes of oxide.

3. *Platinum and Zinc, per se*, do not combine, the zinc burning into oxide.

4. *Platinum and Lead* unite quietly, forming a brittle globule.

5. *Platinum and Thallium* unite quietly; the resulting globule is dark externally, gray internally, and quite brittle.

6. *Platinum and Bismuth* unite quietly, or with merely slight spitting, into a dark brittle globule.

7. *Platinum and Copper* combine quietly, though not very readily, into a hard, light-coloured, malleable globule.

8. *Platinum and Silver* unite quietly, but not very readily unless the silver be greatly in excess, into a white malleable globule.

9. *Platinum and Gold* unite quietly, forming (if the gold be somewhat in excess) a yellow malleable globule.

10. *Gold and Tin* unite quietly into a very brittle globule.

11. *Gold and Zinc* do not combine *per se*; the zinc burns into oxide.

12. *Gold and Lead* combine quietly, forming a grey brittle bead.

13. *Gold and Thallium* unite quietly, but separate again to some extent during cooling. The globule may thus frequently be flattened out, but not without cracking at the sides. If the metals remain united, the button is dark blackish grey, and quite brittle.

* Communicated by the Author.

14. *Gold and Bismuth* unite quietly and readily, forming a very brittle globule.

15. *Gold and Copper*, and 16, *Gold and Silver*, unite, and form a malleable globule.

17. *Silver and Tin* unite quietly into a malleable globule.

18. *Silver and Lead* unite readily into a malleable globule.

19. *Silver and Thallium* combine readily; globule, malleable.

20. *Silver and Bismuth* unite readily and quietly; the globule is brittle, but admits of being slightly flattened out.

21. *Silver and Copper*, and 22, *Silver and Gold*, form malleable globules. The gold alloy, even with gold largely in excess, is quite white. If it be flattened out, and heated in a platinum spoon with some bisulphate of potash, it will become yellow from the silver on the surface being dissolved. On re-melting the flattened disc, a silver-white globule is again obtained.

23. *Copper and Tin* unite into a grey and partially malleable bead, the surface of which, in the O.F., becomes more or less thickly encrusted with cauliflower-like excrescences of oxide.

24. *Copper and Zinc* do not quite *per se* into a globule, the zinc burning into oxide. Under carb.-soda, or carb.-soda and borax, brass is readily formed.

25. *Copper and Lead* form a dark grey globule, which is sufficiently malleable to admit of being extended on the anvil.

26. *Copper and Thallium* melt into a dark grey malleable globule.

27. *Lead and Tin* unite readily, but the globule commences immediately to oxidise, throwing out excrescences of white and yellow oxide. On removal from the flame it still continues in ignition, and pushes out further excrescences. The unoxidised internal portion (if any remain) is malleable.

28. *Lead and Bismuth* unite readily; the molten globule acquires a thin dark coating of oxide on the surface only, and admits of being flattened out, more or less upon the anvil.

29. *Lead and Thallium* form a malleable globule.

30. *Bismuth and Tin* unite readily, but the fused mass immediately throws out excrescences, and becomes covered with a dense crust of oxides. The reaction, however, is not so striking as with lead and tin.

31. *Thallium and Tin* exhibit the same reaction as lead and tin, but the cauliflower-like excrescences are brownish black.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 18th, 1877.

Professor Odling, F.R.S., Vice-President, in the Chair.

After the names of the visitors had been announced and the minutes of the previous meeting read and confirmed, the following names were read for the first time:—Messrs. Michael Conroy, A. Pearson Luff, A. W. Glover, J. Angell, J. Bardsley, and M. Algernon Adams. Messrs. William Hampton, John Comyns Leach, and the Rev. D. W. Ladley were balotted for and duly elected after their names had been read the third time.

The first paper, by Dr. E. Jæger, "*On some Derivatives of Dithymyl-trichlorethane*," was read by the Secretary. The author prepares the substance by the action of sulphuric acid diluted with one-third its volume of acetic acid in a mixture of chloral (1 mol.) and thymol (2 mols.). It forms colourless monoclinic crystals, melting at 198°, and by the action of oxidising agents is converted into thymoquinone. Dithymyl-trichlorethane,—

$$CCl_3.CH<\begin{matrix}C_{10}H_{12}.OH\\C_{10}H_{12}.OH\end{matrix}$$

when heated with zinc dust yields *dithymylethane*,—

$$CH_3.CH<\begin{matrix}C_{10}H_{12}.OH\\C_{10}H_{12}.OH\end{matrix}$$

and *dithymylethane*,—

$$CH_2=CH<\begin{matrix}C_{10}H_{12}.OH\\C_{10}H_{12}.OH,\end{matrix}$$

the former crystallising in flat plates, which melt at 180° and the latter in needles melting at 170°. By the action of feeble oxidising agents the latter yields a green crystalline compound, *dithymyl-quin-hydronethene*,—

$$CH_2=C<\begin{matrix}C_{10}H_{12}.OH\\C_{10}H_{12}.O\end{matrix}\quad\begin{matrix}OH.H_{12}C_{10}\\—\\OH_{12}C_{10}\end{matrix}>C=H_2C,$$

which, by the further action of the oxidising agent is transformed into a red substance *dithymyl-quinone-ethane*,

$$CH_2=C<\begin{matrix}C_{10}H_{12}O\\C_{10}H_{12}O\end{matrix}>$$

These are related to one another and to the parent hydrocarbon in the same way that green quin-hydrone and quinone are related to hydro-quinone.

The Chairman said the Fellows were much indebt to the author for introducing to their notice these complex compounds related so nearly to the quinones.

Dr. Armstrong said the experiments of Dr. Jäger possessed considerable interest, and although he agreed with him as to the formula he had assigned to the quinone, he could not say as much for that attributed to the green crystals, for it must be remembered that in the formation of green quinhydrone 3 molecules of quinone took part, and not 2, so that it was highly probable that the author's green compound should be represented as derived from 3 molecules of quinone and not 2 only.

The next paper, "*A Preliminary Account of Some New Reactions in Organic Chemistry and their Ultimate Bearings*," by Mr. C. T. Kingzett and Dr. H. W. Hake, was read by the former. After referring to the colour reaction known as the "Pettenkofer reaction," produced by the action of strong sulphuric acid on a mixture of sugar and cholic acid and some other substances, as glycocholic, hyocholic, oleic, and lithofellic acids, &c., and various compounds occurring in brain substance, the authors state that they have found that many other bodies behave in a similar manner, as benzene, phenol, turpentine, camphor, salicylic acid, pyrogallol, piperin, morphine, clove, and other essential oils, and various fatty bodies. Camphor dissolves in concentrated sulphuric acid, forming a deep red solution, and this, when mixed with cane-sugar syrup, solidifies to a rose-coloured paste; but on adding water the colour is destroyed, and an almost colourless precipitate produced, which is soluble in ether. When treated with sulphuric acid it now gives the colour reaction without the addition of sugar, although even when boiled for several hours with dilute sulphuric acid no sugar could be detected in the solution; so that this substance differs in a marked manner from the ordinary glucosides. From a comparison of the reactions yielded with the Pettenkofer test by benzene, benzoic acid, and phenol on the one hand, and turpentine, camphoric acid, and camphor on the other, the authors are of opinion that camphor stands in a somewhat similar relation to turpentine that phenol does to benzene, that camphor indeed may be the phenol of turpentine and not a ketone as ordinarily supposed. The authors concluded with some observations on the ultimate bearings of these new reactions, which they consider to cover a very wide field; leading, for instance, to the question of the general constitution of sugars and similar problems. Some of the reactions mentioned in the paper were exhibited.

Dr. Odling having thanked the authors for their interesting paper, Mr. C. E. Groves asked whether they considered the new compound obtained with the camphor

solution and [illegible] to [illegible] of the nature of a glucoside, and whether the cane-sugar which they employed was converted into glucose during the reaction.

Mr. KINGZETT replied that from the difference observed when such bodies as benzamide were substituted for sugar in the reaction, he considered it probable that glucose might be formed. The compound, however, was not an ordinary glucoside or saccharide, as it was not decomposed by boiling with dilute acids; he believed, however, it would prove to be of the nature of a substitution derivative of a hexatomic alcohol, $C_6H_6(OH)_6$, in which one or more OH groups were replaced.

Dr. ARMSTRONG said they were much indebted to the authors for bringing before their notice these interesting colour reactions, but he thought the facts adduced as yet did not justify the speculative conclusions which they had drawn, as, for instance, that the relation between camphor and turpentine was similar to that between phenol and benzene.

Mr. KINGZETT replied that, although he had not done so, he could give structural formulæ to illustrate his meaning, and proceeded to show how some of the brain substances were split up under the action of sulphuric acid when they gave this colour reaction. With regard to the relation between turpentine and camphor he considered there was strong evidence to prove that camphor, was a phenol, and comparatively little to show that it was a ketone. The relation was brought out distinctly on comparing the formula—

Benzene, C_6H_6	Turpentine, $CH_3.C_3H_7.C_6H_6$
Phenol, $C_6H_5.OH$	Camphor, $CH_3.C_3H_7.C_6H_5.OH$

Dr. WRIGHT remarked that, although one argument in favour of the hydroxyl nature of camphor was its behaviour with such reagents as zinc chloride and phosphorus pentasulphide, giving rise to cymene, yet, on the other hand, with phosphorus pentachloride it yielded dichlorinated derivatives, which was not in accordance with the ordinary behaviour of alcohols under similar circumstances.

The next paper, on "*Dinitroso-orcin and Dinitro-orcin*," by Dr. J. STENHOUSE, F.R.S., and Mr. C. E. GROVES, was read by the latter, an abstract of which will be found in another part of the journal.

The CHAIRMAN having thanked the authors,

The SECRETARY read a paper, by Dr. T. CARNELLEY, "*On High Melting-Points, with Special Reference to those of Metallic Salts, Part* III." The author has determined the "time-values" of nine standard salts by comparing the time of melting with that of sulphur; the times of melting of the different salts always bearing a constant ratio to one another and to sulphur, and this ratio is the time value for each given salt. By interpolation the author has constructed a table giving the melting-points corresponding to various time-values from 0 to 241.

After the CHAIRMAN had thanked the author in the name of the Fellows, he adjourned the meeting until Thursday, February 1, when there will be a paper by Dr. H. E. Armstrong, "On Kekulé's and Ladenburg's Benzene Symbols," and one "On the Formation of Coumaric, Cinnamic, and other Analogous Acids from the Aromatic Aldehyds," by Mr. W. H. Perkin.

PHYSICAL SOCIETY.

January 20th, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidate was elected a member of the Society:—A. G. Greenhill, M.A.

Dr. HUGGINS exhibited an enlarged view of a photograph, half an inch in length, of the spectrum of the star α-Lyræ, which he has recently taken in a manner similar to that in which the spectrum of Sirius has already been obtained. The first results were very unsatisfactory, in consequence of the clockwork being insufficient for maintaining the image of the star on the slit for a length of time. Mr. Grubb has, however, devised a secondary control apparatus, the employment of which renders it impossible for the error to exceed one-tenth of a second. In the spectroscope employed the prism was of Iceland spar, and the lenses of quartz. Dry plates were employed, and the necessary breadth was secured by slightly changing the position of the image instead of by the use of a cylindrical lens. Dr. Huggins has also been engaged in taking a series of photographs of the moon, and hopes to obtain some information in regard to the question of a lunar atmosphere of small extent. In the spectrum of α-Lyræ a line occurs corresponding with H in the solar spectrum, and several more refrangible ones which he is at present unable to explain.

Mr. LOCKYER considered the results which Mr. Huggins is obtaining to be of extreme importance, and he pointed out how he hopes a large series of photographs of stellar spectra will afford valuable information in regard to the constitution of certain substances now supposed to be elementary, such as calcium. Some time ago he communicated a paper to the Royal Society on the spectrum of this metal, and he considers that it is not a simple substance, but that the H lines are due to two elementary substances of which it is composed; and this supposition is confirmed by the fact that in the photograph exhibited by Dr. Huggins only one of the H lines is present,—that is, only one of the constituents of the metal calcium is present in the star α-Lyræ.

Mr. W. C. ROBERTS read a paper on the "*Artificial Production of Columnar Structure*." He gave an account of the several theories which have hitherto been given as accounting for this phenomenon and that of cross-jointing as observed in the Giant's Causeway, and he dwelt specially on the views of Mr. R. Mallet and Prof. James Thomson. He found, as the result of experiment, that when certain masses of clay and sand are heated to about 1300° C. they contract to about the same amount as a basalt does in passing from the molten to the solid state, and that beautiful columnar forms are produced. He had hoped, by accumulating a number of specimens, to have been able to establish a relation between the strains at the point of rupture and the dimensions of the hexagons; but in the small masses employed the strains were so numerous that it was impossible to apportion their influences. He had, however, obtained a number of specimens which possessed much interest.

Mr. LECKY referred to a very fine columnar cliff in the island of Bedness, in Valencia Harbour, which he has examined in the hope of finding cross-joints, but, although some breaks exist, there are none at all comparable to those in the north of Ireland.

Prof. GUTHRIE showed an arrangement he has recently devised, in the hope of making the mercurial as sensitive as the water barometer. It consists of an ordinary syphon barometer, in which the two vertical tubes are united by means of a long, uniform, horizontal tube, having a diameter considerably less than that of the main tubes. The instrument is filled in the same manner as the ordinary syphon barometer, except that a bubble of air or dilute acid is left in the narrow tube. For a given rise of pressure the absolute amount of mercury which passes from the shorter to the longer tube depends upon their diameters, and, as this is great in comparison with the tube uniting them, the motion of the bubble will be considerable in comparison with that of the summit of the mercurial column. In the instrument exhibited the horizontal tube was formed into a spiral, in order that the vertical tubes might be in close proximity.

He then exhibited a number of thin india-rubber balloons filled with water, which he has arranged with a view to illustrate the nature of jellies. When a jelly sets it is assumed that the solid matter collects in the form of cells containing liquid, which burst on the application of heat. By weighing at intervals one of these india-rubber bags, he

has found that evaporation takes place from its surface. Thus with a bag weighing initially 749·4 grms., there was a loss of 0·95 grm. in the course of twenty-four hours. He is also examining a bag filled with salt water, and immersed in water, in order to ascertain whether salt as well as water is capable of traversing the septum.

Lastly, Prof. Guthrie exhibited a large series of Chladni's rings rendered permanent on cardboard by pressure, in contact with the plate which had been caused to vibrate, in a copying-press. The sand and lycopodium were caused to adhere firmly by dilute gum.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

January 15th, 1877.

Prof. A. W. Hofmann, F.R.S., Vice-President, in the Chair.

The Council reported that the decennial Anniversary of the Society would be observed by the issuing of a complete Index to the *Berichte* for the first ten years.

Prof. C. Liebermann stated that, in connection with Dr. Benzinger, he had obtained a "*Mono-nitro-thymol*" which yielded, through the amido-compound, thymoquinon, and gave an experimental proof that the quinon group is formed from an hydoxyl group and a nitro group of dinitro-thymol.

F. Tiemann and N. Nagai described "*Homo-Vanillic Acid and Homo-Protocatechuic Acid.*" The former, $C_9H_{10}O_4$, was obtained along with vanillic acid, by the oxidation of a solution of acet-eugenol in acetic acid with potassium permanganate. It possesses a much greater solubility in water than vanillic acid, but otherwise has nearly the same properties. Treatment with hydrochloric acid yields CH_3Cl, and homo-protocatechuic acid, $C_6H_3(OH)_2CH_2COOH$. This acid is more stable and soluble than protocatechuic acid, gives also much brighter colour-reactions with a ferric solution, and by distillation of the calcium salt yields homo-pyrocatechin.

F. Tiemann and A. Herzfeld read a paper "*On the Formation of Para-Cumanic Acid*," which was obtained from para-oxy-benzaldehyd.

H. Vogel described "*The Spectroscopic Reactions of Purpurin.*" A solution of perfectly pure purpurin gives two prominent bands between D and E, and between B and F. The spectrum disappears at once upon the addition of a trace of lime. It was found that the presence of 0·000002 grm. of CaO in a litre of the solution was sufficient to cause this change. No effect was produced by the addition of BaO or SrO.

The Secretary read the following communications from non-resident members :—

S. Bogusky and N. Kajander, "*Rapidity of the Evolution of Carbonic Acid.*" Experiments were performed with Carrara marble and five acids—HNO_3, HBr, HCl, CH_2O_2, and $C_2H_4O_2$. The first three appeared to obey a fixed law, that the quantities of carbonic acid evolved in a unit of time are inversely proportional to the molecular weights of the acids. Formic acid and acetic acid did not show this regularity, apparently in consequence of a physical change in the surface of the marble.

A. Christomanos, "*On the Analysis of Chrome-Iron Ore.*" The author recommends a calcination of the roughly powdered ore before the final pulverisation, and suggests some changes in the method of carrying out the analysis.

A. Basarow, "*On a Lecture-Experiment illustrating the Explosive Character of Certain Substances.*"

F. Frehrichs, "*A New Method of Organic Analysis.*" The essential features consist in combustion with oxide of mercury, absorption of the water by phosphoric anhydride, and use of the air-pump.

A. Ladenburg, "*On the Constitutional Formula of Oxy-thymo-quinon.*"

A. Ladenburg and O. Struve, "*On the Quantivalence of Nitrogen.*" The authors defend the trivalence of this element from the comparison of the two compounds $N(C_2H_3)_3C_2H_3I$ and $N(C_2H_3)_2(C_7H_7)C_2H_3I$.

R. Anschütz and G. Schultz, "*On Phenanthren.*" The authors give directions for the preparation of phenanthren and its quinon. By the action of NH_3 upon the latter, the compound $C_{14}H_9NO+H_2O$ was obtained.

H. Sauerlich, "*On the Action of Sulphuric Acid upon Tri-oxy-benzoic Acid and Benzoic Acid.*" The result is a quinon, $C_{14}H_8O_4$, forming crystals with a metallic lustre.

A. Benuthsen, "*On Sulph-acetamid.*" Colourless crystals obtained by the action of sulphuretted hydrogen on aceto-nitrile, melting at 108°. Prof. Hofmann called attention to the fact that numerous investigators had sought in vain to obtain this compound.

The following communications were received by the Secretary before the close of December, and appear in the *Berichte* for 1876 :—

E. Elsasser, "*On Electrolytic Action with Evolution of Hydrogen at Both Poles.*" This occurs when a platinum-magnesium element is immersed in very dilute sulphuric acid, or when the two metals in a solution of $MgSO_4$ serve as poles for a battery, the magnesium forming the anode. In both cases exactly half as much hydrogen is liberated on the anode as on the cathode.

C. Böttinger, "*On the Acids possessing the Formula* $C_5H_6O_4$." These three acids—citra-, ita-, and metaconic acids—all yield, by reduction with zinc-dust, ordinary pyro-tartaric acid, ita-conic acid showing the most resistance to the reaction. Citra-conic acid was obtained as a by-product in the preparation of pyro-tartaric acid from pyro-racemic acid.

A. Lauberheimer, "*On Ortho-dinitro Compounds.*" The author shows that the dinitro-chloro-benzene previously obtained by him is a meta-para compound in regard to the Cl atom, by changing it into chloro-nitraniline. His experiments would also prove that all ortho-dinitro compounds yield sodium-nitrite and a phenol by treatment with sodium hydrate, and ammonium-nitrite with the corresponding amide by treatment with alcoholic ammonia.

E. Glatzel, "*Some New Compounds of Titanium, and Experiments on the Solution of the Metal in Acids.*" Solution of the metal in HCl gave $Ti_2Cl_6+8H_2O$; in H_2SO_4 the corresponding sulphate, $Ti_2S_3O_{12}+8H_2O$, laminated cryssals yielding bright blue solutions. Nitric acid changes this sulphate into $TiS_2O_8+3H_2O$—a yellow, resinous, exceedingly hygroscopic body. Titanium fluoride, $TiFl_4$, was obtained by solution in hydrofluoric acid, but always in company with small amounts of TiO_2. The reactions of $Ti_2S_3O_{12}$ with solvents are so similar to those of the so-called titanate of iron that the author regards this mineral as consisting of isomorphic mixtures of Ti_2O_3 and Fe_2O_3. In the dioxide compounds Ti stands between Sn and Si; in the sesquioxide compounds it belongs to the group of Fe, Al, Mn, and Cr, showing the most resemblance to iron.

E. Erlenmayer, "*Extraction of the so-called Soluble Phosphoric Acid from Superphosphates.*" The author finds that acid phosphate of lime, $CaH_4(PO_4)_2+H_2O$, requires 700 parts of water for perfect solution, and that with a smaller amount of water a certain quantity of the salt is changed into free phosphoric acid, and insoluble $CaHPO_4+(H_2O)_2$. Mösker's process of extracting the phosphoric acid on the filter is therefore only to be used with superphosphates containing sufficient free acid to prevent this decomposition; otherwise as much as 8 per cent of the acid present passes over into the insoluble salt. Superphosphates containing no free acid yield correct results if digested with an amount of water at least 700 times the weight of the acid phosphate present.

"*A Simple Preparation of Alkaline Cyanides.*" Fusion of sodium with anhydrous ferrocyanide of potassium yields a colourless fluid mass, easily poured off from the metallic iron, and becoming snow-white on congelation.

It contains 40 per cent of cyanogen in combination with the alkaline metals.

$C_{12}N_{12}Fe_2K_8 + Na_4 \cdot 4CyK + 8(CyK)S + (CyNa)_4 + 12e_2$. "*Preparation of Normal Valerianic Acid from Normal Caproic Acid.*" The latter is changed by Br into a bromo-caproic acid, then treated with H_2SO_4, oxidised with a solution of chromic acid, and finally distilled. The distillate contains valerianic acid.

E. Fischer, "*Aromatic Hydrazin Compounds.*" Diphenyl-nitrosamine yields by reduction diphenyl-hydrazin, $(C_6H_5)_2N-NH_2$. It is isomeric with hydrazo-benzene, but the reactions of the two are strikingly unlike.

F. von Lepel, "*Spectral-Analytical Reactions for Salts of Magnesia.*" The presence of magnesia salts in solution modifies so characteristically the absorption-bands in the spectrum of purpurin that a solution of the latter can be used to detect the presence of a fraction of a milligrm. of a magnesia compound, even in company with the salts of the alkalies and alkaline earths.

H. Limpricht, "*Action of Bromine on the Silver Salts of Benzene Sulphonic Acids.*" $C_6H_5SO_3Ag$ gives, with bromine, meta-bromo-benzene-sulphonic acid. The silver salts of ortho-, meta-, and para-bromo-benzene-sulphonic acid, give with the same treatment various dibromo-sulphonic acids, from which tribromo-benzene-sulphonic acid is obtained by the same process. Nitro-benzene-sulphonic acid yields no results. The amido-benzene-sulphonic acids show a variety of complicated decompositions. On account of the properties, salts, and reactions of nitro-meta-bromo-benzene, sulphonic acid follows.

I. Remsen, "*On Phosphoric Oxychloride.*" This is easily produced by the action of ozone on the trichloride.

H. Beckurts and R. Otto, "*On α-Dichloro-Propionic Acid.*" This acid, $CH_3.CCl_2.COOH$, is obtained from *α*-dichloro-propionitrile by treatment with H_2SO_4; boils at 190°; gives, with reducing agents, propionic acid; and with Ag_2O, acetate and carb-acet-oxylate of silver.

J. H. van 't Hoff, "*On Benzene Formulæ.*" Kekulé's hexagonal formula is defended against the proposed prism of Ladenburg.

H. Schroder, "*On a Surprising Regularity in the Volume Relations of Certain Series of Compounds.*" The author has found, from numerous experiments, that the specific volumes of the various members of a series of compounds almost invariably stand in simple arithmetical relations to the specific volume of the common element or component, which not only imparts to the series its characteristic chemical behaviour, but also exerts a dominant influence on the volumes of the different compounds. For example, Ag possesses the sp. vol. 10·28; Ag_2O gives $30·8 = 3 \times 10·28$; Ag_2I_2 gives $82·2 = 8 \times 10·28$; $C_3H_3O_2Ag$ gives $51·4 = 5 \times 10·28$; pyrargyrite, $3Ag_2S + Sb_2S_3$, gives $185 = 18 \times 10·28$. Si possesses the sp. vol. 11·3; quartz, SiO_2, gives $22·6 = 2 \times 11·3$; diathen, $Al_2O_3.SiO_2$, gives $45·2 = 4 \times 11·3$; &c.

H. Klinger, "*On Thialdehyds.*" The author corrects erroneous statements with regard to the formation of thi-acetaldehyd, and describes a third isomeric, thiobenzaldehyd, obtained from benzoic aldehyd by the action of SH_2.

E. Berglund, "*Amido-sulphonic Acid.*" The author obtains it in the form of the Ba salt, by boiling barium imido-sulphonate with water and boric hydrate:—
$R_2O_2.(SO_2)_2NH + 2H_2O = R_2O_2.SO_2 + H_4N.O.SO_2.OH$.

A. Aronheim, "*Action of Stannic Chloride upon Benzene.*" The vapours of the two bodies passed through a heated tube give $SnCl_2$, HCl, and $(C_6H_5)_2$, with no traces of an organic compound of tin. The process can be used for the preparation of diphenyl.

W. Michler and C. Dufertius, "*Synthesis of the Ketones derived from Dimethyl-Aniline.*" Dimethyl-aniline, upon treatment with $COCl_2$, yields, according to the temperature, hexamethyl-triamido-dibenzoyl-benzene, and tetramethyl-diamido-benzophenon. The latter is reduced with sodium-amalgam to the corresponding benzhydrol, the perfectly colourless crystals of which possess the remarkable property of imparting an intense blue to colourless solvents—as ether, alcohol, and acetic acid. Benzoyl-chloride and dimethyl-aniline yield dimethyl-amido-dibenzoyl-benzene, large well-formed crystals melting at 55°.

E. Meyer, "*On β-Amido-propionic Acid and β-Guanido-propionic Acid.*" Improvements on the method of preparing β-amido-propionic acid from glycerin, and theoretical considerations with regard to the formula of β-guanido-propionic acid.

H. W. Vogel, "*Methods for Detecting the Adulteration of Wines.*" The author compares the methods at present in use, and proposes the use of the spectroscope for this purpose, adding the results of a variety of experiments. The presence of fuchsine is shown by its characteristic absorption-band between D and E. *Ligustrum vulgaris* gives bands at D and F. The colouring-matter of mallow-leaves is also easily detected in the same way.

W. Michler and A. Gradmann, "*Synthesis of Organic Acids and Ketones by means of Carbonyl-Chloride.*" Diethyl-aniline gives, by treatment with $COCl_2$, diethyl-amido-benzoic acid, $(C_2H_5)_2N.C_4H_4.COOH$; and the chloride of this acid, by further treatment with diethyl-aniline, yields hexo-ethyl-triamido-dibenzoyl-benzene, and tetra-ethyl-diamido-benzophenon.

A. Claus, "*On Melamine Sulpho-Cyanate.*" This compound, $C_3H_6H_6.CNSH$, is obtained by heating $NH_3.CNSH$ at 250°; prismatic yellow crystals.

"*On a New Method of Preparing Stearic Acid.*" Ricinoleic acid, $C_{13}H_{34}O_3$, gives, with HI *in statu nascendi*, iodo-stearidic acid, $C_{18}H_{33}IO_2$, a yellowish oil, and this upon reduction with zinc yields stearic acid.

O. Doebner and W. Stackmann, "*Action of Benzo-Trichloride on Phenol.*" The result is benzoyl-phenol, $C_6H_5CO.C_6H_4OH$, analogous to the synthesis of salicylic aldehyd with $CHCl_3$.

H. Landolt describes the details of his arrangements for illustrating, by means of the magic lantern, various chemical reactions, such as the development of coloured vapours, liquefaction of gases, sublimation, crystallisation, &c.

S. Stein advocates the use of rock crystal for scale-beams, thermometers, normal weights, and measures of length.

W. Thörner describes a simple apparatus for fractional distillation in a partial vacuum.

C. Bulk describes an alteration in the construction of the ordinary filter-pump, by means of which the water-power can be used to produce also a forcible stream of air, and gives an account of a new separatory funnel, more easily regulated than those at present in use.

NOTICES OF BOOKS.

Chemical and Physical Researches. By Thomas Graham D.C.L., F.R.S., &c. Collected and printed for presentation only. Preface and Analytical Contents by Dr. R. Angus Smith. Edinburgh: 1876.

Thomas Graham's faithful friends, Dr. Angus Smith and Mr. James Young, could hardly have erected a more fitting and lasting monument to his memory than by reprinting in a collected form his various papers and researches, hitherto scattered through a number of *Transactions* of learned societies and scientific journals, many of which are long since dead and forgotten, while others are not to be obtained in libraries out of England. The papers are forty-six in number, the first being his researches on "The Absorption of Gases by Liquids," contributed to the *Annals of Philosophy*, in 1826, when the writer was still nearly a year under age, and ending with his famous memoir on "The Relation of Hydrogen to Palladium, and on Hydrogenium," first published in the *Proceedings of*

the Royal Society in January, 1869, the series thus extending over a period of forty-five years.

Thomas Graham was born in Glasgow in December, 1805; studied chemistry under Dr. Hope, of Edinburgh; took his M.A. degree at Glasgow University in 1826; and was made Lecturer to the Andersonian Institution in 1830. In 1837 he was made Professor of Chemistry at the London University, and in 1855 succeeded Sir John Herschel as Master of the Mint, a post he retained until his death in September, 1869.

His working life, as far as published researches go, may be said to begin with his paper on "The Absorption of Gases by Liquids," published in the early part of 1826. The young chemist seems to have been singularly struck with Faraday's experiments on the liquefaction of gases, and the boldness with which he asserts that gases ought to be regarded merely as volatilised liquids, and that in solution they exist in the liquid form, must have startled some of the more conservative of the chemists and physicists of half a century ago. In this article there is a fine piece of analogical reasoning, which augurs well for the boy chemist's future powers. "There is nothing," he says, "impossible or even surprising in the fact of water at 60° F. absorbing ammonia, muriatic acid, or sulphurous acid, and thereby converting them into liquids, when we consider that concentrated sulphuric acid heated to 600° F. will absorb and convert into liquid the vapour of water heated to the same degree; that is to say, nearly 400° F. above its vapourising-point." This, we believe, was the first time that the analogy between gases and vapours was so clearly and strikingly enunciated. The coolly satirical manner, too, in which he speaks of *reputed* liquids and gases must have been a sore trial to the temper and the nerves of the orthodox of that day. It is interesting to compare these bold generalisations with his speculations with regard to the passage of hydrogen through palladium as being the result of "the solution of liquid hydrogen in the colloid metal" (p. 290), and with the almost absolute certitude with which he gives the specific gravity of solid hydrogen, and insists on its being a white metal possessed of ductility and tenacity, capable of conducting heat and electricity, and even possessing magnetic powers, in the very last research he ever published. It is a curious psychological phenomenon to find the same mind applying itself at the dawn as well as at the sunset of life to the selfsame task—the breaking down of the barriers between gases, liquids, and solids.

Passing over several papers on "Nitrification" and other subjects, we come to his first researches on the diffusion of gases through each other, published in the *Quarterly Journal of Science* in 1829. In this paper he describes minutely his first experiments on the spontaneous movement of gases, a subject which he afterwards pursued with such brilliant results up to the very end of his career. In this paper he consistently treats the vapours of water and alcohol as gases. This paper is followed by one on the bursting of a bladder half-filled with coal-gas in an atmosphere of carbonic acid, an experiment which seems to have led to his employing colloid septa in most of his subsequent researches. For the next two years he published but little, and apparently employed the interval in prosecuting his experiments on gas diffusion, and in deducing laws from the phenomena he observed. In 1831 he read his great paper "On the Law of the Diffusion of Gases" before the Royal Society of Edinburgh. Graham seems to have been first induced to experiment in this direction by an observation of Döbereiner's, who found that hydrogen standing over water in a fissured bell-jar escaped so rapidly that the water gradually rose to several inches above the level of the trough. Graham apparently began his experiments with fissured vessels, but soon abandoned them for Wedgwood tubes and plaster-of-Paris plugs. The enunciation of the law that the velocity of diffusion of gases is in inverse proportion to the square root of their density was the most important result which Graham had yet obtained, and gained for him the Keith Prize before he had completed his twenty-fifth year. In this paper, too, we have the first speculation as to the part played by the laws of gas diffusion in regulating certain physiological functions. The continuous distension of the tubulæ of the lungs and of the respiratory system of insects is accounted for by the greater velocity with which oxygen passes inwards through the colloid septa forming their walls as compared with the passage of the carbonic acid outwards. In this paper, also, we first perceive the earliest glimpse of his belief as an atomist:—"My experiments . . ." he says, "afford the first demonstration of the fact that diffusion takes place between the ultimate particles of gases, and not between sensible masses." He concludes by shooting a Parthian arrow at the inventors of more or less unfounded hypotheses by declaring that the law at which he has arrived is merely a description of phenomena, and involves nothing hypothetical.

Passing over a paper on "Phosphuretted Hydrogen," which shows an immense amount of that patient research which was one of his distinguishing characteristics, we come to one which was read before the British Association in 1845, "On a New Property of Gases," which gives an account of his experiments on the effusion of gases into a vacuum, a subject which was much more fully treated of in the following year in the *Philosophical Transactions*, in which the effusion of gases into a vacuum through perforated plates, and their transpiration through capillary tubes are described. These experiments, especially those on transpiration, presented numerous apparent anomalies, but the passage of gases through minute apertures into a vacuum appear to be governed by the general law similar to that regulating their diffusion. The second part of this paper appeared in the *Philosophical Transactions* for 1849, the experiments therein detailed showing that the laws of effusion through an orifice, and of transpiration through capillary tubes, are different, although velocities in the latter case bear a constant relation to each other. His next work on gases is on their molecular mobility, and was published in the *Philosophical Transactions* for 1863, his attention in the meantime having been devoted to other matters. In these experiments he used plates of Brockedon's compressed graphite, the pores of which are so exceedingly minute that they are impenetrable to a gas in mass. In this paper he joins Herapath in revising Dr. Bernoulli's hypothesis that a gas consists of solid and perfectly elastic spherical particles, which move in all directions, their velocity being different in different gases. The graphite plates enabled our philosopher to compare the laws of diffusion and transpiration with greater accuracy, showing more conclusively than before that they have no relation to each other. This paper also contained a large number of experiments on atmolysis, or the partial separation of mixed gases by diffusion into a vacuum. The tube atmolyser is also described, the diffusion tubes used being Dutch tobacco-pipe stems enclosed in glass tubes. The inter-diffusion of gases through large apertures likewise received considerable elucidation, the experiments showing that in perfectly still air its molecules spontaneously alter their position, and move to a distance of half a metre in any direction in the course of five or six minutes. This, we believe, is the first time that the correctness of the kinetic theory was placed beyond all reasonable doubt by actual measurement, and the connection between the convection by gases and their molecular movement made apparent. Three years after (in 1866) Graham published his researches on the "Absorption and Dialytic Separation of Gases by Colloid Septa," showing that, so to speak, liquids act as carriers of gases through such media, those gases which are the most soluble passing through the quickest. These researches appear to be the outcome of the experiment of the inflation and bursting of a bladder half-filled with coal-gas in an atmosphere of carbonic acid before alluded to, the media used being india-rubber, varnished silk, bladder, &c. The second part of this paper describes the action of metallic septa on gases at a red heat, in a series of researches instigated by those of H.

Sainte-Claire Deville and Troost, on the passage of gases through red-hot platinum and iron. In these experiments he showed that platinum at a red heat was more permeable to hydrogen even than caoutchouc at ordinary temperatures, other gases being almost entirely stopped. He also found that red-hot platinum not only transmitted hydrogen, but actually absorbed or *occluded* it, retaining it on cooling. But the prime discovery in this paper was that of the wonderful force possessed by palladium of occluding hydrogen, which was the first step towards his theory of hydrogen being a metal. He also demonstrated the colloid nature of platinum, palladium, and other metals by showing that osmium-iridium, being crystalline, was incapable of occluding hydrogen. He also proved that palladium occluded hydrogen, even at ordinary temperatures, and that it absorbed water, alcohol, oil, and other liquids to a certain extent. The courageous way in which Graham speaks of liquid hydrogen, and of its evaporation from the surface of palladium foil, reminds one of his boldness in breaking down the distinction between gases and liquids in his very first paper. His subsequent idea of the existence of hydrogen does not appear yet to have struck him, his first view being that hydrogen is occluded by palladium in a liquid form, the liquid gas differing little in its specific gravity from the hydrocarbons, and being excessively volatile. He also considers that in passing through the graphite plate of a diffusiometer hydrogen is at any rate partially liquefied. This paper was quickly followed by one on the occlusion of hydrogen by meteoric iron, proving that the Lenarto meteorite contained three times its volume of occluded hydrogen, and that it must hence have been extruded from a dense atmosphere of that gas. These researches were quickly followed by his famous paper on the "Relation of Hydrogen to Palladium, and on Hydrogenium," in which he announced his method of charging palladium with hydrogen by making the metal form the negative electrode of a voltaic battery. By this means he succeeded in making palladium absorb 936 times its volume of hydrogen, its density being diminished and its bulk increased. From various experiments he deduces the density of hydrogen in the solid metallic form, having apparently abandoned his hypothesis of a liquid. Other experiments showed that the compound of palladium and hydrogen was moderately magnetic, palladium being but feebly so. His reasoning on this subject is peculiarly close. The fact of gaseous hydrogen not being magnetic is no obstacle to his theory, for, as he justly observes, magnetism is liable to extinction by heat. He also claims for it the electric conductivity as well as the tenacity, ductility, and malleability of a metal.

So far, Graham's researches on gases, in comparison to his other labours, must be considered to be those on which his fame principally rests.

In his researches on salts and solutions we see the same leading idea always at work—the investigation of the atomic structure of matter. His discovery of the relations of the phosphates, and the modifications of phosphoric acid, did much to lay the foundations of the modern chemical theory of polybasicity, and his investigations into the part played by water as a constituent of salts threw a flood of light on many points which had long remained unaccounted for. His theory of the voltaic circle, too, was a most brilliant one, especially that portion which explained the apparent travelling of hydrogen and oxygen from one plate to another. In 1849 he first published an account of his experiments on the diffusion of liquids, which, although perhaps not so brilliant as those on gas diffusion, are none the less important in their way. As gas diffusion led to atmolysis, so liquid diffusion led to dialysis, and his division of liquids into two new classes, colloids and crystalloids, formed an era in the history of the molecular structure of bodies. He also applied his method of transformation through capillary tubes to liquids, but his patient and laborious work in this direction bore but little fruit. As a piece of speculative reasoning his paper on the constitution of matter will always be read with admiration. It appears in some sort to be a confession of faith on the part of the writer, who asserts his belief that various kinds of matter possess the same ultimate molecule in different conditions of movement, this universal mobility pervading all gaseous, liquid, and solid bodies. In this paper we cannot help being astonished at the boldness and closeness of the reasoning, although some may demur to the conclusions drawn therein, a remark that will apply with equal force to his views about hydrogenium. As Dr. Angus Smith remarks in his excellent preface, "Graham was a true descendant of the early Greeks, . . . and in all his works we find him steadily thinking on the ultimate composition of bodies."

Amongst his most prominent characteristics were his singular powers of interpreting the results of his investigations; his indomitable patience and industry in performing countless numbers of the most tedious experiments; his steady pursuit of a single object—the atomic constitution of matter; as well as the candid courage with which he announced his conclusions when once he found them justified by his experiments. The theories of his time had but little influence on him, and his researches were conducted independently of them, his conclusions being always drawn from work done by himself. His mind was singularly free from narrowness, and his speculations are distinguished by a breadth of view that places them far above the mushroom hypotheses that are constantly springing up.

An analytical table of the contents of each paper and a copious index will greatly facilitate the work of the student. Considering the general value of the book it seems a pity that it should have been printed for private circulation only.

Dr. Angus Smith's preface to this valuable work gives a succinct account of the atomic theory from Leucippus to the present day, as well as a general sketch of Graham's labours.

Dr. Angus Smith also gives in the preface the following complete, though short, summary of the "Heat and Kinetic Theory:"—

"We pass to the next important stage, namely, the motion of gaseous molecules, if not of atoms, and the beginning of the attempt to define it precisely. The first definite ideas are by D. Bernoulli. They are explained in his Hydrodynamics,* which, although published in Strasbourg in 1738, were previously worked at when he was Professor in St. Petersburg.

"D. Bernoulli says—'The chief peculiarities of fluids are these: 1st, they are heavy; 2nd, they expand in all directions unless they are confined; and, 3rd, they allow themselves to be compressed more and more, according to the increased force applied.' Speaking of a vessel of air with a weighted cover, and which he illustrates with a diagram, he says—'So the minute bodies, whilst they impinge on the cover E F, keep it up by their continually repeated strokes, and form an elastic fluid, which expands itself when the weight is removed or diminished.' 'We shall consider the corpuscles enclosed in the hollow of the cylinder as infinite in number, and when they occupy the space E C D F we shall say that they constitute the natural air.'

"Davy and Count Rumford entered the field when this theory of gaseous motion was forgotten, and inaugurated a new theory of heat founded on molecular activity. That heat is immaterial was no rare opinion last century, or since Lord Bacon spoke of it as *motus et nihil aliud*. However, atomic motion ceased from the time of Rumford to be a vague idea. Davy† spoke definitely when, without calling in the aid of forces, he supposed that in solids the particles are in a vibratory motion, the particles of the hottest bodies moving with greatest velocity and through the greatest space; that in fluids and elastic fluids, be-

* Danielis Bernoulli, Joh. Fil., Med. Prof. Basil. *Hydrodynamica, sive de viribus et motibus Fluidorum Commentarii* (Argentorati, 1738), p. 200.

† "Collected Works," vol. iv., p. 67.

sides the vibratory motion, which must be considered greatest in the last, the particles have a motion round their own axes with different velocities, the particles of elastic fluids moving with the greatest quickness; and that in ethereal substances the particles move round their own axes and separate from each other, penetrating in right lines through space. Temperature may be conceived to depend on the velocity of the vibrations, increase of capacity on the motion being performed in greater space, &c.

"This is evidently the work of Rumford and Bernoulli, with additions after passing later through an original and powerful mind.

"We may take the next step to Herapath.' At p. 15, vol. i., he says —

"'*Theory of Gases.*—From these considerations it follows that if a number of small bodies be inclosed in any hollow body, and be continually impinging on one another and on the sides of the inclosing body; and if the motions of the bodies be conserved by an equivalent action on the sides of the containing body, then will these small bodies compose a medium, whose elastic force will be like that of air and other gaseous bodies; for if the bodies be exceedingly small, the medium might, like any aëriform body, be compressed into a very small space; and yet, if it had no other tendency than what would arise from the internal condition of its atoms, it would, if left to itself, extend to the occupation of a space of almost indefinite greatness. And its temperature remaining the same, its elasticity would also be greater when occupying a less, and less when occupying a greater space; from a compressed state the number of atoms striking against a given portion of the containing vessel must be augmented, and the space in which the atoms have to move being less, their motions or periods must be shorter, and the number of them in a given time consequently greater; on both of which accounts the elasticity is greater the greater the compression. Besides, when other things are the same, the elastic force augments with an augmentation of temperature and diminishes with a diminution; for an increase of temperature, according to our theory, must necessarily be attended with an increase of velocity, and therefore with an increase in the number of collisions.'

"Joule took up the subject immediately after Herapath, and says†—'Since the hypothesis of Herapath, in which it is assumed that the particles of a gas are constantly flying about in every direction with great velocity, the pressure of the gas being owing to the impact of the particles against any surface presented to them, is somewhat simpler. I shall employ it in the following remarks on the constitution of elastic fluids,' &c. Dr. Joule continued the subject, and introduced it into the region of experiment and observation, or, in other words, to the science of modern times.‡ Joule might have added that the view he adopted is not only in accordance with the known laws of the elasticity of gases, but conforms to the ratio of the specific heats of gases. The mathematical development continued to make progress in the hands of Clausius, Clerk Maxwell, Holtzman, and others, taking us to new fields, and outside the region of Graham's activity."

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—The interesting and suggestive letter from Captain Marshall Hall, which appeared in the CHEMICAL NEWS, vol. xxxv., p. 19, deserves attentive consideration from all Fellows of the Chemical Society.

An opportunity seems now to be at hand for raising the Society to a place of distinction commensurate with the true value of chemical science. We see rising indications of a removal of the veil which has too long concealed these proportions. It begins at length to be apparent that the future place of nations will be determined by original research and not by exalted classical attainments.

When recently in the tomb of Agamemnon, at Mycenæ, were found the attenuated remains of a tall Trojan monarch with golden mask and diadem, chemical knowledge suggested an alcoholic solution of gum juniper by which the frail structure was preserved.—I am, &c.,

G. A. KEYWORTH.

Hastings, January 16, 1877.

STEEL ANALYSIS.

To the Editor of the Chemical News.

SIR,—The writer of the article "On the Estimation of Phosphorus by the Phospho-Ammonio-Molybdic Salt," &c., in the CHEMICAL NEWS (vol. xxxv., p. 1), and on the "Calculation of Chemically Combined Carbon," &c. (vol. xxxv., p. 17), while recommending "improvements," gives no proof of his statements any further than his own authority, and as I feel it my duty to protest against his deductions and methods of working, I may perhaps be permitted a little space in your journal to criticise the articles referred to.

With regard to the article on the "Estimation of Phosphorus," &c., he objects to Eggertz's method for three reasons. I may dismiss his first reason.

2. Because "a certain quantity of the yellow precipitate is dissolved and passes through the filter with the solution." If such is the case the objection applies equally to his own "improvement," as he must wash the yellow precipitate free from iron, or use citric or tartaric acid to prevent the iron from being precipitated.

3. "Because the precipitate is slightly soluble in acidulated water;" and, secondly, "because a small quantity of the acid always remains on the filter, from which the filter, when dried is always a little rotten."

With regard to the first part of this objection, it also applies to his own method, that is, assuming for the sake of the argument that it is an objection. The difficulty of the rottenness of the filter can easily be got over by simply washing the precipitate on to a small weighed capsule, evaporating to dryness, and weighing; a very common proceeding, and one which I think ought to suggest itself to anybody, and I scarcely think that Prof. Eggertz claims the weighing on the filter as an essential part of his process.

With regard to his "method" it has all his objections to the molybdate process, with none of its advantages. By using 1 grm. (as he recommends) of the iron or steel a very small precipitate is got, which renders the process quite unfit for determining small quantities of phosphorus. In a Bessemer steel, for example, containing 0·1 per cent P (rather a high percentage), the precipitate of $Mg_2P_2O_7$ would weigh 0·0039 grm., a fact which chemists who have such work to do will quite appreciate.

M. Kern also makes a mistake when he says that the ignited precipitate ($Mg_2P_2O_7$) contains 13·51 per cent P; I think 27·92 per cent is the proper figure.

With regard to his article on the "Calculation of the Percentage of Chemically Combined Carbon," &c., his whole improvement consists in diluting a solution of 0·1 grm. of a standard steel containing 0·31 per cent carbon to 8 c.c. (why 8 c.c. ?), and then explaining how the value of each c.c. is to be calculated. Thus—

$$\frac{0{\cdot}31}{8} = 0{\cdot}0038 \text{ per cent of carbon.}$$

—I am, &c.,

WILLIAM GALBRAITH, F.C.S.

Sheffield, January 16 1877.

* "Mathematical Physics," &c., by John Herapath. 2 vols., 8vo. 1847.

† *Memoirs of Lit. and Phil. Soc. of Manchester*, vol. iv., 1851, p. 111.

‡ See "Math. Physics," vol. i., p. 264.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 1, January 3, 1877.

Cause of the Movement of the Radiometer.—MM. Berlin and Garbe.—There has been a prolonged discussion on the question whether the disks of the radiometer revolve in virtue of the direct action of the calorific or luminous source, or if their movement was produced by the air enclosed in the apparatus. M. Schuster was the first who made the important remark that if the cause of the movement was internal the case, if suspended, ought to turn in a direction contrary to the disks, which he has indeed demonstrated. But Mr. Crookes having obtained a contrary result,* we wished to know the truth, and have therefore undertaken the experiments which we now describe to the Academy.

Efflux of Mercury from Capillary Tubes.—M. E. Villari.—The quantity of mercury which flows in a second of time is proportional to the pressure under which the efflux takes place, to the fourth power of the radius of the tubes, and inversely proportional to the length.

Rotatory Power of Mannite and its Derivatives.—M. G. Bouchardat.—The author finds that mannite possesses a specific rotatory power, which is augmented whenever mannite enters into a composition, such as the formation of ethers, or when it is dissolved in water charged with boracic acid, borax, caustic soda, and some other salts.

Researches on Melezitose.—M. A. Villiers.—Not suitable for abstraction.

No. 2, January 8, 1877.

Does Ozone Combine with Free Nitrogen in Presence of Alkalies to form Nitrous Compounds and Nitrates?—M. Berthelot.—The view that ozone combines with free nitrogen at ordinary temperatures, in presence of alkalies, forming nitrous compounds, is very generally maintained, on the authority of Schœnbein ("Deukschrift über das Ozon," p. 16; Basle, October, 1849), and is considered as one of the principal sources of natural nitrification. M. Berthelot has verified the observations of Schœnbein on the formation of nitrous compounds during the slow oxidation of phosphorus in contact with the air, but he has not succeeded in proving the oxidation of free nitrogen by ozone in presence of alkalies.

Decomposition of Urine, with reference to the Recent Communications of Dr. Bastian.—MM. Pasteur and Joubert.—A continuation of the controversy on abiogenesis.

Observations on the Internal Structure of one of the Masses of Native Iron from Ovifak.—M. Daubrée.—The author considers it still doubtful whether the native iron of Ovifak is of a cosmic or of a terrestrial character.

Determination of the Polar Distance in Magnets.—M. R. Benoit.—A mathematical paper, incapable of useful abridgment.

Experiments on the Coagulation of Fibrin.—M. A. Schmidt.—The coagulation of fibrin in certain liquids of the animal economy is due to the presence of an albuminoid substance, which, from a chemical point of view, closely approaches the fibrino-plastic substance.

Effects of Heat on Voltaic Circuits completed by an Electrolyte.—M. W. Hellesen.—Not suited for abstraction.

* This is an error. Mr. Crookes's experiment on the rotation of the glass case of a magnetic radiometer, described to the Royal Society, March 30, 1876, corroborated Dr. Schuster's views.

Action of Sulphate of Lime on the Alkaline Sulphates.—M. A. Ditte.—The sulphate of lime combines with the sulphates of potassa and of rubidium, forming double salts. With the sulphate of soda a similar double salt is formed on more prolonged contact, whilst with the sulphates of soda, lithia, magnesia, and thallium no double salts are formed, even after contact prolonged for several months.

Camphor of Patchouli.—M. J. de Montgolfier.—This compound has the composition indicated by the formula $C_{30}H_{26}O_2$, and is therefore an isomer of the camphor of cubebs, and belongs to the type of the hydrates derived from the carbides, $(C_{10}H_8)\,n$.

Reimann's Farber Zeitung.
No. 42, 1876.

A new colour has been introduced into the market under the name of napolin or nopalin. Some of the samples are said to consist of eosin, and others of a cochineal.

The Indian (Japanese ?)dressing for textile materials known as Hai Thao is sold now in Paris at 6½ francs per kilo.

There is an article by M. Glanzmann (*Bull. de la Soc. Ind. de Rouen*) on the patent colours of Croissant and Bretonnière, which are now also manufactured by Poirrier and Co. under the name of Cachou de Laval. For printing purposes these colours are not well adapted. In dyeing, to obtain a certain tone it is requisite not merely to use the same weight of colour to the same quantity of goods, but to keep the dye-bath always at the same degree of concentration. Darker shades are obtained when the goods, after dyeing, are passed through dilute nitric acid instead of through chromate of potassa.

NOTES AND QUERIES.

Tetrachloride of Carbon.—How is the tetrachloride of carbon made, and for what is it used. I notice by your advertising columns that this substance is largely advertised, and I infer that its production must be considerable. It cannot be made like the other chlorides of carbon, by the action of sunlight on chloric ether or other analogous substances, as the process would be too slow and too expensive. I think it must be made by the action of dry chlorine on incandescent coke, or in some such way. In the *Jahresbericht der Chemie* I find its formula, but not the method of preparation; the formula given is $(C.Cl_3)Cl$, or $(C.Cl_3)_n$. I saw a short time since in your columns an abstract of a patent specification, in which was specified the use of this substance to make non-drying oils dry in varnishes (which, by the way, I do not think possible); but that set me thinking about it. I inquired of the editors of the *Scientific American* (the only question I ever asked from them), and they could not answer. An answer through your columns will oblige.—C. (Dayton, U.S.A.).

Pig-Iron Containing Manganese.—Can any reader of the Chemical News favour me with the following information regarding the metallurgy of manganiferous pig-iron:—In smelting manganiferous iron-ore, is there any definite relation between the amount of manganese in the iron produced and the amount of Mn in the slag accompanying it, and if so what are the usual proportions? If a certain iron-ore containing no manganese yields 35 per cent Fe, and 45 per cent slag, what percentage of manganiferous hæmatite, containing about 10 per cent Mn and about 50 per cent Fe, must be added in order to produce a pig-iron containing 1 per cent manganese.—Ferro-Manganese.

Milk Analysis.—The examination of milk has become a matter of great importance to society, and chemists are continually called upon to report the relative amounts of butter and other constituents which this valuable article contains. The following method has been found to yield very reliable results for the determination of fat. A quantity of milk, from 10 to 12 grms., is weighed in a small porcelain basin, evaporated to dryness on a water-bath, and the residue very carefully transferred to a tube closed at one end) of hard combustion glass, about 10 inches long, and ¾ of an inch in diameter. The basin is rinsed several times with ether, and poured into the tube, which is closed with a tightly fitting cork, and the thumb closely pressed upon it. The tube is then placed in water, the temperature of which is sufficiently high to raise the etherial solution to its boiling-point, and the contents are briskly shaken for a few minutes; when cool, the solution is filtered into a weighed platinum dish, and the residue again treated in a similar manner. I have found that after three treatments of this kind, not a trace of fat remains in the residue. The dish containing the solution is placed in warm water, and gently evaporated, finally transferred to a water-bath, and heated until weight remains constant. In four determinations of fat by the foregoing method 3·24, 3·23, 3·30, and 3·31 per cent respectively were obtained.—J. Snell.

THE CHEMICAL NEWS

Vol. XXXV. No. 897.

ON THE QUANTITATIVE DETERMINATION OF NITRIC ACID BY INDIGO.

By ROBERT WARINGTON.

The determination of nitric acid by means of a solution of indigo is a method possessing the great advantages of speed, simplicity of execution, and ability to measure extremely minute quantities of the substance sought. The method is already in constant use by several English chemists, and the recommendation of it in the new edition of Sutton's *Volumetric Analysis*, and especially the very satisfactory series of test experiments contributed by Mr. W. Thorp, will doubtless lead to an extensive trial of it by many chemists. As the method has recently been examined with some care in the Rothamsted Laboratory, it will perhaps save time and trouble to other investigators if a short account is given of the results obtained.

There are two somewhat distinct methods of employing indigo for the determination of nitric acid—that of Boussingault, in which hydrochloric acid is the medium of the reaction, and that originated by Marx, in which sulphuric acid is employed. Boussingault's method is given in full in his *Agronomie, Chimie agricole et physiologie*, ii., 244, published in 1862. As this work is probably inaccessible to many chemists, it will be well to commence with a brief account of Boussingault's method, more especially as no reference is made to it by Marx, or by any of the German writers following him.

In Boussingault's method 2 c.c. of the nitrate solution to be examined are placed in a test-tube, a drop or two of solution of indigo added, and then ½ c.c. of pure hydrochloric acid; the whole is then heated. As the colour of the indigo disappears more is added. When the colour ceases to fade, the liquid in the test-tube is concentrated by boiling. If concentration fails to destroy the blue or green colour, another ½ c.c. of hydrochloric acid is introduced. The reaction is completed when neither concentration, nor fresh addition of hydrochloric acid, destroys the excess of indigo present. The colour produced by a small excess of indigo is a bright sap-green: this tint is the final reaction sought. The small excess of indigo necessary to produce a green colour is deducted in every experiment.

It is evident that in Boussingault's method it is advisable to use as small a bulk of indigo solution as is consistent with an accurate determination of the quantity employed, the concentration in the test-tube will else become tedious. Boussingault employs three indigo solutions of decimal strengths: their values are determined by experiments with pure nitre.

The largest amount of nitric acid Boussingault deals with is about 0·016 grm.; the smallest quantity that can be distinctly determined is 0·00000054 grm. The error in a determination may apparently sometimes amount to 5 or 6 per cent of the nitrate present, but with proper care will generally be considerably less.

Boussingault early discovered that the presence of certain kinds of organic matter was fatal to the accuracy of the determination. If sugar, dextrin, or gelatin were present, the results found were far too low, the oxidising power of the nitric acid being exerted on these as well as on the indigo. On the other hand, citric, tartaric, acetic, and oxalic acid were without effect: ammonium salts, also, had no influence. The organic matter of rain-water had a marked effect, and nitrates intentionally added to rain-water could not be determined with accuracy, the result being far too low. Boussingault found that he could meet this difficulty by distilling the mixed nitrate and organic matter with bichromate of potassium and sulphuric acid, the distillate containing the whole of the nitric acid free from organic matter. Nitre mixed with ten times its weight of sugar was thus satisfactorily determined. With nitrogenous organic matter the bichromate did not succeed equally well, a part of the organic nitrogen being converted into nitric acid, and the result being consequently too high. Boussingault then tried distillation with peroxide of manganese and sulphuric acid. This plan gave good results in the presence of moderate amounts of organic matter, whether nitrogenous or not; but with large quantities of sugar the results were not so good as with bichromate. Distillation with peroxide of manganese and sulphuric acid was the method finally adopted by Boussingault. It is performed in a very small retort half-filled with broken glass. 1 grm. of the peroxide and 1 c.c. of oil of vitriol are introduced, with a few cubic centimetres of the nitrate solution; distillation is carried on till white fumes appear; 2 c.c. of water are then added to the contents of the retort, and distillation resumed: the rinsing with 2 c.c. of water is again repeated.

If chlorides are present, free chlorine would be produced during the distillation with manganese, and be reckoned as nitric acid in the titration with indigo. If chlorides are in considerable quantity they are to be removed before distillation, by treatment with silver, &c.; but if the amount is small they need not be removed: the distillate is in this case treated with a little ammonia, and brought to boiling for an instant; free chlorine is then immediately destroyed.

Such is Boussingault's method, which he has largely employed in his numerous investigations: it is used by several French chemists, but has not met with any general adoption.

The second indigo method is that originated by Marx, and published by him in 1868 (*Zeitschr. f. anal. Chem.*, vii., 412). He mixes the nitrate solution with twice its volume of oil of vitriol, and then quickly runs in a solution of indigo from a burette till a small excess of indigo is present. Numerous investigations of this method have appeared in Germany; the principal are by Trommsdorff, Goppelsroeder, and Bemmelen. A form of this method has been recently recommended by Sutton, as already mentioned. As this method promised greater speed and simplicity than that adopted by Boussingault, it is the one which has been lately examined at Rothamsted.

The amount of indigo that is oxidised by a nitrate mixed with oil of vitriol depends on a great variety of circumstances. Instead of describing what different investigators have said on this subject, it will be simpler to enumerate in order the various points brought out in the present series of experiments, and merely refer from time to time to the statements of other observers.

In all the following experiments the indigo employed was a filtered solution of so-called "indigo-carmine." The nitre solution was of the strength recommended by Sutton (10 c.c. = 0·01011 grm. KNO_3), unless the contrary is stated: 10 c.c. of this solution was the volume used in each experiment. The oil of vitriol was pure distilled acid.

I. *The maximum amount of Indigo is consumed only when a sufficiency of Indigo is present with the Nitrate before the addition of Oil of Vitriol.*

If a nitrate solution is treated with a proper volume of oil of vitriol, and indigo immediately run in from a burette till an excess is present, and a second experiment be afterwards made in which the nitrate solution and the measure of indigo just consumed are first mixed, and the same volume of oil of vitriol added as before, it will be found that the indigo is now quite insufficient, though all the volumes remain the same as in the first experiment. When, by successive trials, the maximum amount of

indigo oxidisable by the nitrate has been ascertained, it will be found far larger than that shown in the first experiment.

This fact is fully recognised by Bemmelen. He states that the amount of indigo required, when added after the nitrate is mixed with oil of vitriol, is only about one-half the maximum quantity of indigo oxidisable by the nitrate. No definite proportion can, however, be fixed, as the volume of indigo used under the first named conditions is greater the quicker the operation is conducted.

The small amount of indigo consumed when the indigo is run from a burette into the mixed nitrate and sulphuric acid is not owing, save in small part, to the cooling of the mixture; nor by keeping the mixture for some time at a high temperature can any considerable further quantity of indigo be oxidised. These facts were ascertained by placing the flask in which the experiment was made in a bath of melted paraffin, kept at a temperature of 125° to 130° C. The simplest explanation of the facts is to suppose that nitric acid is lost on mixing a nitrate solution with oil of vitriol, and that therefore the full oxidising power of the acid is only ascertained when an excess of indigo has been present from the beginning. It seems questionable, however, whether the loss of nitric acid can in weak solutions be so considerable as to account fully for the phenomena observed.

In the results hereafter mentioned the quantity of indigo consumed will always be the *maximum*, ascertained in each case by a series of approximating experiments, in which the whole of the indigo was added before the oil of vitriol.

II. *The amount of Indigo required depends greatly on the proportion of Sulphuric Acid present, and within certain wide limits the amount of Indigo is less as the proportion of Sulphuric Acid is greater.*

This rule will be made at once evident by giving the results of a single series of experiments, in which the maximum amount of indigo oxidised by a fixed quantity of nitrate was ascertained for various proportions of sulphuric acid:—

Nitre Solution taken.	Indigo Solution required.	Oil of Vitriol for 1 Vol. of Mixed Nitre and Indigo.
10 c.c.	11·30 c.c.	1
10 ,,	10·40 ,,	1½
10 ,,	9·75 ,,	1½
10 ,,	8·90 ,,	2

It appears from these figures that the largest amount of indigo was oxidised when an equal bulk of oil of vitriol was added to the mixed nitre and indigo solutions, and that when the proportion of oil of vitriol was raised to twice this quantity only about 79 per cent of the indigo previously required was oxidised. The larger, in fact, was the proportion of oil of vitriol, the smaller was the quantity of indigo consumed.

This fundamental law is not mentioned in any of the published investigations I have seen; the practical conclusion therefrom, that the same proportion of sulphuric acid must be present in all comparative experiments, is, however, partially stated by Sutton.

The facts described under this and the preceding section plainly show that the method of running indigo from a burette into a nitrate solution mixed with a fixed quantity of sulphuric acid can never yield reliable results. In this mode of working, originally proposed by Marx, and still employed by some chemists, the amount of indigo used is never the maximum quantity which the nitric acid could oxidise, and depends much on the quickness of the operator. The result must also be too low or too high, according as the quantity of nitric acid present is below or above that taken when the indigo was standardised. For it is clear that if less nitric acid is present, less indigo will be employed than was used in standardising; the proportion of sulphuric acid in the experimental mixture will therefore be greater; and we have just seen that if the proportion of sulphuric acid is increased, less indigo is consumed by each unit of nitrate.

It further follows, from the above law, that to obtain accordant results it is necessary that the oil of vitriol should always be added to the mixed nitrate and indigo solutions in a perfectly uniform manner. If any considerable part of the reaction takes place in the presence of less acid than the final proportion, as will be the case when the acid is gradually mixed, more indigo may be oxidised than properly belongs to the proportions used. On the other hand it is easy, by postponing mixing for a few seconds after adding the acid, to obtain low results, a considerable part of the reaction then taking place on the surface of the oil of vitriol, and consequently in the presence of a great excess of acid. The aim should be to effect the mixture in every case as completely and speedily as possible. The best mode of mixing is that recommended to me by Mr. W. Thorp. The nitrate and indigo are placed in a wide-mouthed flask of about 150 c.c. capacity. The measured quantity of oil of vitriol is placed in a test-tube or cylinder. The contents of the cylinder is then rapidly transferred to the flask, and the whole at once shaken. Irregularities of manipulation have their greatest influence when the nitrate solution is strong, and the reaction therefore immediate; errors (of deficiency) occur most readily when a small proportion of acid is used.

I am quite unable to explain why the presence of an excess of sulphuric acid diminishes the oxidising power of the nitric acid present. Sulphuric acid appears, however, to act in the same way with free chlorine, much more chlorine water being required to decolourise indigo in the presence of sulphuric acid than in its absence.

III. *The full amount of Indigo is consumed only when the temperature of the mixture remains sufficiently high during the reaction.*

This fact is abundantly recognised by all writers on the subject. Marx and Trommsdorff mention 100° as the minimum temperature of the reaction; Fischer, 110°; and Sutton, 120°. The heat necessary for the reaction is produced by the addition of the oil of vitriol to the solution. According to Sutton, the addition of 1¼ volume of oil of vitriol will produce a temperature of 135° to 140°: this is true if the oil of vitriol be of full strength, and the reagents at summer temperature. A small diminution in the strength of the acid makes, however, a decided difference in the temperature attained. The greatest heat is produced when 1½ volume of oil of vitriol is employed; with 2 volumes the heat is slightly less, and with only 1 volume is somewhat further diminished.

Experiments were made on the effect of maintaining a full temperature by placing the flasks, immediately the oil of vitriol had been added, in a paraffin-bath of 120°: it was found that no more indigo was required as a result of such treatment, except in cases where the change of tint was not completed for more than half a minute. Such instances will only occur when working with very dilute solutions of nitrates, or in a room of low temperature, or with sulphuric acid deficient in strength. When this tardy reaction is manifested the temperature of the flask must be artificially sustained, or the results will be too low. A bath of chloride of calcium may be employed instead of paraffin.

IV. *The Tint of Final Reaction.*

The tints obtained differ somewhat according to the proportion of sulphuric acid used, the mode in which it is added, and other circumstances: the presence of chlorides also affects the colour.

When the indigo solution is freshly prepared, 1 volume of oil of vitriol employed, the nitre solution of Sutton's normal strength, and the acid suddenly added, the tint belonging to an excess of nitric acid is a deep reddish colour; with more indigo this darkens to a dull brown, and with still more indigo becomes greenish. Bemmelen has rightly stated

that the excess of indigo commences with the brown stage. If the brown solution is poured into several times its volume of water, the colour immediately changes to green. This treatment with water is a very convenient method of ascertaining the final reaction.

When 2 volumes of oil of vitriol are employed, the tint due to excess of nitrate is less deep and red than with 1 volume of acid, and approaches a dark sherry colour; with more indigo this passes through the brown and green stage. The brown, green, and superior tints, when poured into water, yield green for an instant only, the colour quickly passing into cinnamon. The cinnamon solution thus obtained is capable of decolourising a rather considerable quantity of indigo. It will be recollected that with 2 volumes of oil of vitriol far less indigo is oxidised than when a smaller proportion of sulphuric acid is used: it would appear that with 2 volumes of acid some lower oxide of nitrogen remains in solution, and on the addition of water becomes capable of destroying indigo.

With an intermediate proportion of oil of vitriol (1½ volumes) the tints are similar to those with 2 volumes, but more feeble in intensity; the brown tint and the tints superior to it change to green on dilution.

With very weak solutions of nitre the tints obtained with 1 volume of oil of vitriol are similar to those yielded by stronger solutions; the brown is changed into a distinct green on filling up the flask with water. With 1½ volume of acid the final tints are feeble and unsatisfactory. With 2 volumes of acid the tints produced are much deeper than with 1½ volume; the indigo and blue are specially intensified.

The best plan seems to be to adopt the brown tint whenever possible as the point of final reaction, or, more exactly, that particular brown tint which yields a distinct yellowish green on dilution. In all exact work a check experiment should be made with rather less indigo than that yielding this green tint, to make sure that no smaller amount of indigo will produce a similar reaction. Working with 2 volumes of oil of vitriol, the green tint produced by dilution must generally be dispensed with; but if the eye has been educated to the particular shade of brown which yielded green in the former cases, it will be able to discriminate this tint with fair accuracy without dilution. In the case of weak solutions the eye can be helped by transferring the contents of the flask to a cylinder.

In the case of experiments with 1 volume of oil of vitriol, the tint, whether in strong or weak solutions, soon reaches a definite point, beyond which no further change occurs. But with 1½ or 2 volumes of acid the tint continues to change slowly (especially in dilute solutions) after the first main reaction is over; if, therefore, definite results are wanted, it is quite necessary to time the experiment, and to take that as the final tint which is observed at a fixed interval after pouring in the oil of vitriol. I have taken two minutes as the period to elapse before the tint is recorded, but, except in the case of weak solutions, one minute would suffice.

The determination of the final reaction is undoubtedly one of the weak points of the method, but with care and practice the difference between similar experiments need scarcely exceed 1 per cent in the case of moderately strong solutions (1·0 to 0·5 grm. of nitre per litre), and with weak solutions (0·25 to 0·10 grm. per litre) should not be greater than 2 or 3 per cent, supposing that in each case an indigo of appropriate strength is employed.

A few experiments have been made with an indigo solution prepared by dissolving sublimed indigotine in sulphuric acid. With this solution the colour produced by an excess of nitrate is much less deep than with a solution of "indigo-carmine;" the tint is golden and not red, and passes into bright green without an intermediate brown stage. The colour reaction with this indigo solution is very sharp.

To be continued.)

ON THE

DETERMINATION OF THE AMOUNT OF MORPHIA PRESENT IN OPIUM.

By E. F. TESCHEMACHER, F.C.S., &c.

In placing in the hands of Chemists one more process for determining the amount of Morphia present in Opium, it must not be assumed that the labours of my predecessors in this field have been ignored or disregarded by me. Most gladly would I have adopted any one of these numerous processes had it, on trial, afforded similar, definite and reliable results in the amount and purity of the morphia obtained. That these processes fail to yield satisfactory results when they are based on sound methods of procedure, is, to my mind, due, partly to the authors having failed to describe and insist on the necessity of following each and every step, however minute, of their process; and, partly, to their having, too readily, jumped to the conclusion of the excellence and certainty of their methods, without painstaking and long-continued investigation of the subject, and repeated reviewal and testing of every discernible or probable source of error.

On the first of these grounds, I claim the indulgence of all who may take an interest in the subject, for the many minute directions and explanations I shall feel it to be requisite to place before them; and as to the second I would assure them that the process described is but the outcome and result of very numerous experiments, the details and conditions of which have been changed and modified, as frequent practice for some years past proved to be advisable or necessary; so that the method as now worked out and described, but slightly resembles the process in its inception.

Amongst the conditions requisite to success in determining the amount of Morphia present in Opium, are:—

I. The avoidance of the use of Alcohol to extract the Morphia from the Opium. This rule leads at once to the rejection of very many facile and seemingly excellent methods; and the reason for its adoption is, that Alcohol dissolves the whole of the Narcotin as well as the Morphia present in Opium, and that, in practice, it is very difficult if not impossible to separate the whole of the Narcotin under such conditions from the morphia; so it is essential that the greater part of the Narcotin should remain undissolved in the refuse of the opium and never pass into solution.

II. The separation of the Meconic acid. This should be effected at an early stage of the process, so as to prevent the formation of a basic meconate on precipitation of the Morphia, which is very apt to occur unless all the Meconic acid is separated in the first instance.

The other conditions are rather details of the process than definite maxims, and are better included in the description of the method than apart from it.

Two special reagents are required in this process. The one prepared by mixing 1 part of solution of ammonia sp. gr. 0·880 with 20 parts of methylated alcohol, or of unmixed alcohol, and digesting in this mixture a large excess of Morphia for several days, with frequent agitation, so as to saturate it with Morphia. This may then be filtered for use when it will contain 0·33 per cent of Morphia, and for convenience sake may be termed "*Morphiated Spirit.*" The other is, Water saturated by frequent and long continued agitation with excess of Morphia and then filtered, which may in its turn be called "*Morphiated Water,*" containing 0·04 per cent of this alkaloid. It must be assumed that the sample of Opium to be examined has been properly drawn, and prepared by kneading and rolling together in a cool place; but this is best left to a skilled sampler, who is known to be competent to and careful in his work.

Process.

1000 grains of Opium are macerated for twelve to twenty hours in about 4000 grains of cold distilled water, together

with 300 grains of Acetate of Lead, stirring the mixture from time to time. This separates the Meconate of Lead, whilst the Morphia is dissolved in the Acetic acid set free.

After this maceration the Opium may be readily ground in a mortar to a paste and so much more cold distilled water added, rinsing the pestle and mortar with successive portions of it, as to fill with the mixture a measure = 20,250 grains of distilled water: experience has shown that the space occupied by the insoluble matters measures from 200 to 300 grains, so that the limit of possible error by averaging and allowing 250 grains for the insoluble portion amounts to 0·05 per cent in Opium containing 10 per cent of Morphia. The mixture is to be filtered and 15,000 measured grains, =750 grains of opium, of the clear solution are to be evaporated to an extract on a water-bath, and this residue to be drenched with 3000 grains of boiling alcohol or methylated spirit, and the whole digested together with frequent stirring for about ten minutes. This separates the gum, &c., of the opium, which is insoluble in alcohol, and so far frees the solution of Morphia from impurity. At this stage of the process it is well to get rid of the excess of lead-salts, and for this end sulphuric acid is preferable to sulphuretted hydrogen; so much diluted sulphuric acid as may be equal to 30 grains of Oil of Vitriol will almost always be sufficient for this purpose, any excess of acid being converted into sulphate of ammonia by the subsequent addition of so much solution of ammonia as shall be equivalent to the 30 grains of oil of vitriol, thus forming a salt but slightly soluble in the alcoholic solution. This mixture may now be transferred to a beaker and allowed to settle for twelve hours, after which it is to be filtered and the filter and insoluble residue thoroughly washed with alcohol or methylated spirit. This alcoholic filtrate is then distilled, or evaporated on a water-bath to about 1000 grains; when, and whilst still hot, 400 grains of solution of ammonia sp. gr. 0·880 must be added, stirring rapidly and continuously for at least twenty minutes, whilst the beaker or evaporating dish and its contents should be cooled as rapidly as possible by plunging into an external vessel filled with cold water. This rapid and continuous stirring is most important, as the precipitation of the whole of the Morphia *in fine powder* is thereby effected, instead of the granular or mammillated condition so frequently met with, and it thus permits of the easy and thorough separation of all the Narcotin which may be mixed with the Morphia. When the cooling of the mixture and precipitation of the Morphia is thus attained, transfer it quickly and completely to a filter of sufficient capacity to hold the whole, and when the liquid portion has passed through, wash the remainder of the precipitated Morphia, adhering to the dish or beaker, on to the filter, using, for this purpose, the Morphiated spirit already described, and continuing the washing of the precipitate until it is completely freed from the mother-liquor. To do this effectually requires some little care: thus the Morphia on the filter must be kept in a spongy condition and never allowed to cohere, which is easily effected by pouring the Morphiated spirit round the edges of the filter so as not to disturb the precipitate, which must not be permitted to drain or solidify until this washing is completed.

The precipitate is now to be washed from off the filter-paper, with the Morphiated water previously described, and digested therein for a few minutes; which removes some more colouring matter together with any salts soluble in water but insoluble in alcohol which may have adhered to the precipitated Morphia; then once more collect the precipitate on a filter, washing it with Morphiated spirit, after this, once with ether, and finally thrice or more with Benzine, this completely frees it from Narcotin which is very soluble in benzine, morphia on the contrary being insoluble in this liquid. It now remains to drain and dry at a low temperature, say 100° F., the resulting pure and white Morphia, the weight of which will indicate the amount of this Alkaloid present in 750 grains of the opium under examination.

The beakers dishes and funnels employed should be covered, so far as may be practicable, to prevent much evaporation of the liquid made use of, although neither the Morphiated Spirit nor Water deposits any of the alkaloid with which they are charged until the greater portion of the respective liquids have evaporated.

In closing the description of this process, I may be allowed to remark that whilst it is by no means a rapid one, yet it is one that makes but slight demands on the time and attention of the operator, and I must finally be permitted to express my best thanks to Mr. H. Russell Smith for his careful and suggestive assistance in working out and simplifying the method I have now described for determining the amount of Morphia present in Opium.

1, Highbury Park North, London,
January, 1877.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 28.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

In few branches of chemical technology is it possible to show an amount of progress equal to what has taken place in the manufacture of sulphuric acid during the last ten years. On the one hand, the production has been greatly augmented in consequence of the increased manufacture of soda, potash, by the preparation of artificial alizarin, nitro-glycerin, &c. On the other hand, the process of the manufacture of sulphuric acid has undergone essential alterations.

Whilst former investigations were chiefly undertaken in the hope of discovering new methods of procedure and new apparatus for the manufacture of sulphuric acid, attention has latterly been merely directed towards the discovery of new sources of sulphurous acid, of improved kilns, and of a theoretical elucidation of the process in the lead chambers—in use now for a century—with a view to its practical improvement.

Besides the memoirs of various chemists and technologists in the scientific journals the following works on the manufacture of sulphuric acid have appeared:—

1. M. J. Kolb, "Etude sur la Fabrication de l'acide Sulfurique Considerée au point de vue Theorique et Technologique." Lille, 1865. (Study on the manufacture of sulphuric acid considered from a theoretical and technological point of view.)

2. Dr. C. A. Winkler, "Untersuchungen über die Chemischen Vorgänge in den Gay-Lussac' schen Condensations apparaten der Schwefelsäure Fabriken." Freiberg, 1867. (Researches on the chemical processes in the Gay-Lussac columns in sulphuric acid works.)

3. "Handbuch der Chemischen Technologie Herausgegeben von P. A. Bolley, band ii., 1 gruppe, von Dr. P. Schwarzenberg." Braunschweig, 1869. (Handbook of technological chemistry, edited by P. A. Bolley, vol. ii., group 1, by Dr. P. Schwarzenberg.)

4. F. Bode, "Beiträge zur Theorie und Praxis der Schwefelsäure Fabrikation." Berlin, 1872. (Contributions to the theory and practice of the manufacture of sulphuric acid.)

5. Henry Arthur Smith, "The Chemistry of the Sulphuric Acid Manufacture." London, 1873. (A German version by Fr. Bode appeared at Freiburg, 1874.)

* "Berichte über die Entwickelung der Chemischen Industrie Wahrend des Letzten Jahrzehends."

6. Lorenzo Parodi, "Sull' Estrazione Dello Solfo in Sicilia, e Sugli Usi Industriali del Medesimo." Firenze, 1873. (On the extraction of sulphur in Sicily, and on its industrial uses.)

The number of the compounds of sulphur applicable in the manufacture of sulphuric acid has considerably increased in the last ten years. Sulphur is only used in a few establishments; the chief material being iron pyrites, and in certain cases galena, sulphuret of copper, copper pyrites, blende, and Laming's mass.

Concerning new arrangements of the sulphur kilns nothing has been published. We must remark, however, that in certain works the pyrites furnaces have been converted into sulphur burners by the simple substitution of plates of cast-iron for the grate bars in consequence of the high price of pyrites in the years 1871—1873. Heidenreich, of Hanover, first converted his furnaces in the manner above mentioned, and burnt in twenty-four hours 120 kilos. of sulphur per square metre.

In Stettin, Hamburg, and other places sulphuric acid has been latterly made from sulphur in place of pyrites. But with the fall in the price of the latter the use of sulphur has again been abandoned.

The export of sulphur from Sicily has latterly reached the figures given in the subjoined table:—

1862	143,323 tons
1863	147,035 ,,
1864	139,841 ,,
1865	138,232 ,,
1866	179,110 ,,
1867	192,320 ,,
1868	172,387 ,,
1869	170,141 ,,
1870	172,751 ,,
1871	171,236 ,,

For many years sulphur has been largely used in the vineyards of France, Italy, and Spain as a remedy for the grape disease. The increased production of gunpowder and ultramarine require likewise great quantities of sulphur, so that the decreased consumption of sulpur due to the use of pyrites in the manufacture of sulphuric acid has scarcely depressed the exportation from Sicily.

Roasting Pyrites.—The application of iron pyrites for the manufacture of sulphuric acid is now almost universal, and the extraction of this mineral has greatly increased in the last ten years. The largest quantity is consumed in England, and comes from Spain, Portugal, and Norway. The imports of iron pyrites and sulphur into Great Britain amounted in tons to:—(See below.)

France derives its supply of pyrites chiefly from Chessy and Saint Bel, near Lyons; in the north Belgian ores are used in small quantities. The pyrites consumed in Germany are chiefly produced from the "Sicilia" and "Siegena" mines, near Siegen; certain Rhenish mines produce also small quantities, such as the deposit of fine pyrites at Schwelm, Rammelsberg in the Harz district, &c.

The production of pyrites (in tons) in the following mines, amounted to:—

	Belgium.	Chessy and Saint Bel, near Lyons.	Goslar.	Siegen.	Total Prussian mines except Siegen & Goslar
1862	—	45,973	—	14,850	7461
1863	36,244	59,699	—	28,765	5934
1864	29,956	61,103	—	29,115	3437
1865	31,818	63,538	—	34,060	4187
1866	55,004	65,222	—	50,875	4302
1867	41,298	75,653	1599	71,835	4756
1868	37,933	75,656	2635	90,100	3953
1869	31,670	91,020	2689	64,789	6394
1870	28,665	63,464	3225	92,048	3191
1871	42,272	68,797	3324	110,432	4574
1872	40,932	99,000	3640	144,745	964
1873	—	127,000	1217	123,172	3748

The furnaces used in roasting iron pyrites vary according as they are intended for lumps, coarse, or smalls. The burners for lumps agree generally in the point that the ore is roasted on iron grate bars. The kilns employed in England have been repeatedly described—recently by H. A. Smith—and illustrated by diagrams. The individual furnaces are separated from each other by small vaults, and are connected in such a manner that the gases escaping into the lead chambers may have an approximately constant amount of sulphurous acid. Each compartment is closed below by a separate door, at which the spent ores are removed. These doors are closed when a fresh charge of pyrites is introduced into the kiln from above, whereby the escape of any considerable quantity of sulphurous acid during the opening of the upper door is prevented. If the difference of level between the kiln and the flue leading the gases into the chamber is considerable air is drawn in and no sulphurous acid can escape on opening the working door.

The Belgian pyrites kilns have generally fixed grates. Beneath them is a large channel connected with the chimney. Before introducing a fresh charge of ore the workmen go into the channel and remove the exhausted ore which lies upon the grates with long iron hooks. Not to be inconvenienced by dust during this operation they open the damper which connects the channel with the chimney so that fresh air rushes to them in plenty. This arrangement affords at the same time a further advantage. If the access of air to the furnace could be hermetically closed it would be possible to hinder the escape of sulphurous acid when the doors are opened for the introduction of a fresh charge. But as hermetic closing is not practicable in kilns the loss may be avoided with the aid of the long channel. The outer door leading into the channel is closed as tightly as possible, and the damper leading to the chimney is opened just so wide that the air which enters the channel through the imperfect joints of the door passes beneath the grate bars into the chimney, and not up between the bars into the kilns. Too strong a draft would draw air down through the upper or working doors into the kilns, and consequently sulphurous acid would escape from the chimney. The combustion is therefore at a standstill till the new charge is spread out in the kilns; then the damper is closed, and

	Pyrites from—							Sulphur from—
Date.	Norway.	Germany.	Belgium.	Portugal.	Spain.	Italy.	Sundry Places.	Sum Total.	Sicily.
1862	4,975	6,817	9,860	53,296	33,717	—	2187	110,852	54,200
1863	6,736	15,409	12,059	109,180	33,213	—	2628	179,225	43,060
1864	16,087	12,751	7,069	118,489	15,529	—	1065	170,990	40,420
1865	22,229	14,727	2,121	137,787	16,393	—	369	193,626	49,840
1866	38,262	21,574	4,006	165,993	11,910	—	1625	244,396	62,850
1867	77,895	34,592	2,299	105,556	50,222	—	2134	272,698	59,270
1868	63,007	41,559	—	75,883	47,458	794	1019	229,720	64,080
1869	63,091	13,983	—	140,805	99,648	—	2420	319,947	51,580
1870	67,464	14,914	—	174,459	150,996	—	3676	411,512	54,120
1871	74,416	12,809	—	120,573	242,163	—	4581	454,542	—
1872	71,665	5,682	—	180,329	257,429	—	2521	517,626	—

the door leading into the channel is opened as far as the proper working of the kilns requires.

In France movable furnace bars have been used in the pyrites kilns for some time. They were, indeed, already known in 1848. They are convenient for the workmen, and afford besides the advantage in roasting that on moving the bars backwards and forwards only the lowest stratum of the charge falls out. The compartments are mostly separated from each other by arches; the kilns resemble the English pattern, but the stratum of ore is shallower, as for the most part richer, more combustible pyrites are employed.

In Germany kilns for lump pyrites are in use both of the French, the Belgian, and the English kind. A combination of the French and the Belgian kiln was introduced in 1866 in the "Rhenania" chemical works, near Stolberg, and this construction has since been more extensively adopted. The burnt ores are removed by means of revolving bars, because, on the Belgian method workmen often penetrate with their long hooks into layers still rich in sulphur, and thus the burnt ores show too high a percentage. In the "Rhenania" the long Belgian channel beneath the grates has been retained, permitting the introduction of a fresh charge without loss of sulphurous acid. It further permits the introduction of a waggon beneath the kilns, into which the spent ore falls at once and can be removed without the trouble of loading.

(To be continued.)

ON SOME

BLOWPIPE REACTIONS OF PHOSPHORIC ACID.

By MAJOR ROSS, late R.A.

(1.) Professor E. T. Chapman's article on "Blowpipe Reactions" (Chemical News, vol. xxxv., pp. 13, 26, and 36), affords a remarkable illustration of the danger incurred by drawing philosophical conclusions from results effected by *salts* used as reagents before the blowpipe, the confusion attending which was the very reason why I relinquished the use of *borax* and *microcosmic*, or (as the Freibergians call it) "*phosphor*" salt in 1869.

(2.) If I were seriously to propose to the distinguished Editor of this journal, or to any rational chemist, that he should commence an analysis in the "wet way," by attacking its subject with a solution of table salt instead of HCl; with Glauber's salt instead of H_2SO_4; or with cubic nitre instead of nitric acid, he would probably think me mad. Yet this is *precisely* analogous to the operation of commencing a pyrological examination by the solution of a substance in borax or P. salt before the blowpipe; a proceeding even less philosophical than the other, because here we have a fresh element of uncertainty introduced, viz., our ignorance of the comparative *volatility* of the constituents of these reagents, when their bases and acids are probably disconnected by the addition before the blowpipe, of other acids, or bases, or salts.

(3.) Prof. Chapman (who, if I mistake not, is an old Freiberg student, cited more than once in Plattner's "Probirkunst") says, with reference to Plattner's assertion that the P. salt "reaction" for silica—*i.e.*, the non-solution of silica in P. salt—is concealed by opalescence in the bead, caused by a "certain saturation" of the *base* of the silicate, when it consists of lime, magnesia, glucina, or yttria, "the inference implied in the above statement is quite erroneous. The opalescence of the glass arises entirely from precipitated silica." Prof. Chapman further states—"A simple experiment will show that this is the true cause of the opalescence. If some pure silica (or a silicate), in a powdered condition, be dissolved before the blowpipe in *borax* until the glass be nearly saturated, and some P. salt added, and the blowing continued for an instant, *a precipitation of silica will immediately take place*, the bead becoming opaque white on cooling. This test may be resorted to for the detection of silica in silicates which dissolve with difficulty in P. salt alone, or which do not give a well pronounced 'skeleton' with that reagent." I have italicised the words in the above quotation, which seem to me to represent an unauthorised induction from the experimental premises.

(4.) Obviously, the philosophical and most satisfactory way of solving the doubt which had arisen in Prof. Chapman's mind would have been for that eminent pyrologist to have either attempted—

A. The solution of silica in *pure phosphoric acid* before the blowpipe; or

B. The solution of phosphoric acid in *pure silica* before the oxy-hydrogen blowpipe.

He will find the results of A. in my work, "Pyrology, or Fire Chemistry," among which there is no such thing as opalescence. If he had tried operation B. in certain proportions, he would have probably produced a very fair imitation of the "Noble Opal."

(5.) Prof. Chapman, however, might have inferred the real cause of opalescence from the process followed in the ordinary manufacture of "*opaline glass*" (in which a phosphate, as bone-ash, *must* be employed), first discovered by Neri in 1610, whose recipe is "60 parts of fine white sand, 40 of potash, 10 of finely pounded bone-ash." Fontaineu afterwards improved the opaline appearance by mixing 576 parts of his glass (in which rock-crystal and lead are the chief ingredients) with 10 of silver chloride, 2 of *magnetite*, and 26 of bone-ash.

(6.) In India, in 1869, I attempted to make imitation opals, but not having the means of fusing pure silicic acid, I used instead, a substance known by chemists to bear great analogies to it, viz., *boric acid*. A trace of phosphoric added to a bead of boric acid before the blowpipe constitutes, on cooling, an almost perfect imitation of an opal, which, however, soon absorbs moisture from the atmosphere, and becomes opaque. There can be no analogous "precipitation" of boric acid here. Moreover, boric, dissolved in a bead of phosphoric acid to saturation, causes *no* opalescence. In fact, the former phenomenon constitutes the basis of my process for detecting phosphoric acid (*vide*, "Pyrology," pp. 185 to 191).

(7.) The *rationale* of the phenomenon of opalescence as regards P. salt added before the blowpipe to a saturated solution of silica in borax, seems to be that boric acid, being the most volatile constituent, is gradually expelled, silicic acid taking its place until sodium silicate (or glass) is formed. In the *Proc. Roy. Soc.*, vol. xx., is described an extremely hard bead I thus formed by dissolving silica in borax little by little for a whole fortnight. The fusion of phosphoric acid into this siliceous borax then occasions opalescence. The *constitution* of this opalescence is a subject for further enquiry.

(8.) To sum up. We see from operation B., paragraph (4.) that this opalescence cannot be, as Prof. Chapman confidently affirms it to be, due to "precipitated silica," for silica could scarcely be precipitated in a *medium* of fluid *silica*, and we should not fail to note the difference between "opacity," or "milkiness" as it is variously called, and *opalescence*. All cloudiness in an otherwise clear medium would appear to be due to opaque matter suspended in it, in a state of extremely minute division, but the most powerful microscope fails to resolve true opalescence into particles. It may be recognised by its property of appearing *yellow* by transmitted, *blue* by reflected light. Has Prof. Chapman discovered what occasions the opalescence of an *opal*?

(9.) A *second* edition of Von Engeström's translation of Cronstedt was published in 1772, the *first* being published in 1770. I presented a copy to the Cambridge University library in 1875. Magellan's edition (in two volumes) was the *third*, not the second as stated by Prof. Chapman. With regard to the discovery, if it can be so called, of the formation of a silica skeleton, when Bergman said that "silica is very slowly attacked by microcosmic salt," he stated in precise language the whole "reaction." It is, in short, a mere matter of solution, or

rather of non-solution, but I found that phosphoric acid dissolves about 5 per cent of desiccated silica, so that P. salt, containing soda, probably dissolves more. It is therefore an inefficient test for less than 5 per cent of silica, and Berzelius knew this very well. I found, in 1871, that a water solution of phosphoric, and even of boric acid, dissolves silica boiled in it to some extent, but Von Kobell published the former fact before I did in the tenth edition of his "Bestimmung der Mineralien," Munich, 1873.

of 800° to 1000° F. is required to work off a batch of salt-cake in a reasonable time; and where the arch of the furnace has been built as high as 4 ft. 9 ins. or 5 ft. above the bed, it is difficult to get the requisite degree of heat; consequently, the charge occupies double or treble the proper time for finishing, thus causing a loss of time, fuel, and labour. Insufficient draught through the condensers has in other cases operated to prevent the furnace being properly heated. Want of draught is of course fatal to

ANALYSES OF IRON ORES, LIMESTONES, COALS, &c., USED IN THE IRON MANUFACTURE IN SCOTLAND.

By WILLIAM WALLACE, PH.D., F.R.S.E., F.C.S., Public Analyst for Glasgow, &c.

(Continued from p. 27).

TABLE III.—HÆMATITE IRON ORES.

Constituents.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Peroxide of Iron	73·30	79·66	69·20	82·57	63·00	84·57	90·28	79·00
Oxide of Manganese	0·54	0·54	2·36	0·44	0·72	trace	0·20	0·36
Lime	0·94	—	3·67	0·74	1·74	1·01	0·27	1·16
Magnesia	0·40	—	1·57	trace	1·33	0·10	0·24	trace
Carbonic Acid	1·02	—	4·48	—	2·82	0·90	0·47	0·92
Phosphoric Acid	0·16	0·18	trace	0·12	trace	trace	—	—
Sulphuric Acid	—	—	0·24	—	—	—	—	—
Sulphur	—	0·72	—	—	—	—	0·14	—
Iron combined with Sulphur	—	0·61	—	—	—	—	0·12	—
Alumina	2·08	2·75	3·70	0·67	4·09	2·28	1·20	3·52
Silica	14·41	12·60	5·82	14·24	23·20	8·75	3·36	13·36
Water	7·15	2·94	8·96	1·22	3·10	2·39	3·72	2·60
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Iron	51·31	56·37	48·44	57·80	44·10	59·20	63·32	55·30

NOTE.—These Hæmatite ores are used in blast-furnaces in Scotland, and are brought from the North of England, excepting the last, which is Scotch.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, November 30th, 1876.

The PRESIDENT in the Chair.

MR. JONES read the following paper on "*Jones and Walsh's Patent Decomposing Furnace.*" At the special request of the Secretary I propose to read a brief paper on the recent experiences with this patent furnace, trusting that the discussion which may follow will be found of interest to the members.

Since this time last year a number of these furnaces have been erected and got to work on the Tyne, in Lancashire, Glasgow, Dublin, and other places; the experience of working most of these furnaces has been too short to speak positively of the results, and it should be no matter of surprise if the first attempts of the manufacturers have not in every case resulted in perfect success.

The want of complete success, where such has been the case, may be chiefly referred to two heads, viz.:—

1. Want of sufficient heat in the furnace to calcine or finish the sulphates.
2. The modifications, more or less great, that have been made in the construction of the furnace itself or of its details.

With regard to the first, the want of heat has been attributed, in a few instances, to the arch or roof of the furnace being constructed too high above the bed of the pan. It has been found in practice that a heat any furnace, and the remedy is to be sought in the direction of the condensers, connecting pipes, or flues.

A sufficient draught is indispensable to the proper output from the furnace, and no practical difficulty has been found in combining ample draught with the effectual condensation of the hydrochloric acid.

Second, the various modifications in the apparatus which have been tried. In one instance a double arch, as in an ordinary "Blind Roaster," has been tried with a view to keeping separate the gases from the fire and from those of the charge. This plan, however, had to be abandoned from the heat being found insufficient to calcine the charge.

Modifications of the *details* of the working parts have been numerous, chiefly as regards the *stirrers* or *scrapers*, of which a variety of forms have been tried; but so far as I have been able to learn, none of those in the plough shape, rigidly fixed to the cross arms, have been found to answer so well as the loose scrapers or *paddles*, partly owing to the caking of the salt-cake on the sole of the pan.

The best form of stirrer to avoid these evils, and at the same time to thoroughly expose the charge to the heat, is, I believe, still a desideratum. In our own works we have up to the present time found nothing to work better than the original scrapers or paddle blades attached to the cross arms by a wrought-iron shank, with a bolt and eye arrangement.

The greatest change in the apparatus, however, that has been forced upon ourselves and on some of our friends has been the abandonment of *cast-iron* and reversion to our original construction of *wrought-iron* in those portions of the machinery which are exposed to the full heat of the furnace.

It has been a great disappointment to find that not only the strong cross arms but even, in a few instances, the

vertical shaft of 7 to 8 inches diameter of solid cast-metal have, after exposure for some time to a heat of about 1000°, become extremely brittle, and broken down with a slight strain. I am bound, however, to correct this observation in reference to cast-iron from what I have actually seen in an establishment on the Tyne to-day, where cast metal working parts are a complete success, and stand a higher degree of heat than I have met with in other works; there is no doubt, however, that the explanation of this is to be found in the special combination of metal employed in this case.

In two new furnaces which we have recently constructed at our works, cast-iron is entirely dispensed with in the working parts except the scrapers, the cross arms being 5 inches square, wrought-iron, and the vertical shaft of 7 inches solid round iron. No accident has occurred with these in a furnace that has been at work at Middlesbrough for about two months, and in another furnace a pair of such wrought-iron arms, but only 4½ inches square, have been working continuously for 18 months, and are still perfectly sound and good.

It may be well to note that in the last new furnace it has been found an advantage to make the pan 12 inches deep instead of 9 inches, as before, and to have two drawing doors at opposite sides. In a pan of this depth, and 16 ft. diameter, there is no difficulty in working a charge of 6 tons of finished sulphates.

In order to get the arch lower and bring the heat more directly in contact with the charge, the roof of the furnace is carried upon flat metal girders for about one-third of the diameter, at each end, leaving a space of about 6 ft. in the centre, covered by a brick arch, so as to allow space for the diagonal stays to work which attach the cross arms to the vertical shaft.

In some furnaces the stays are dispensed with altogether, which enables the whole arch to be lowered. By this means the roof of the furnace for two-thirds of its length is brought within 3 ft. of the bed of the pan, and the work is expedited accordingly.

Another improvement in the arrangement of these pans is that open ways or passages, 18 inches wide, are left in the bed or brickwork going across from side to side *under the joints of the pan*. By this means any leakage which may occur can be seen and remedied at once, the access to the whole of the joints being quite easy without any stoppage of the furnace; such openings do not cause any damage by expansion and contraction.

It is remarkable how very small the wear and tear upon the pan itself appears to be. A pan recently taken out in our works, after 18 months' continuous use, is in perfect order, and shows absolutely no visible wear in any of the segments. The use of *hot* sulphuric acid of about 140° T. conduces to the safety of the pan, and is found to expedite the finishing of the charge.

The consumption of coke in treating sulphate of soda has averaged about 2½ cwts. per ton of finished sulphate of soda, and about 3 cwts. per ton with sulphate of potash.

In conclusion it may be observed that the following points have been established by this year's working of the Jones and Walsh's patent furnace, viz.:—

1. That nuisance arising from the escape of vapours from the furnaces or from the batches of salt-cake has been almost entirely overcome.
2. That the condensation is effectually performed and the muriatic acid recovered at a strength varying from 24° to 30° T. (See list of chimney tests.)
3. That the finished sulphates are of a superior quality and of a more uniform character.
4. That allowing for the extra cost of coke (as against coal where used) *steam*, &c., a material saving in labour, in wear and tear, and also in sulphuric acid, is effected as compared with the manual labour system of decomposing.

The following is a list of the chimney tests for the last month :—

Analyses of Sulphate of Potash.

By R. R. TATLOCK.

(From Jones and Walsh's Patent Furnace.)

Date.	Chloride.	Free Sulphuric Acid.
August 14, 1876	1·02	1·44
,, 26, ,, ...	0·69	1·84
Sept. 7, ,, ...	0·59	2·10
,, 14, ,, ...	0·81	1·30
,, 20, ,, ...	1·56	1·96
,, 25, ,, ...	0·89	1·64
,, 30, ,, ...	0·87	1·76
October 9, ,, ...	1·23	2·04
,, 30, ,, ...	0·31	1·84
Nov. 3, ,, ...	1·14	1·44

Copy from Test-Book of Chimney Tests for the Month of November, 1876.

TESTED BY A. R. HUDSON.

Date.	HCl per Cubic Foot Escape.
November 1, 1876	0·10 grs.
,, 2, ,, ...	0·10 ,,
,, 3, ,, ...	0·11 ,,
,, 4, ,, ...	0·15 ,,
,, 6, ,, ...	0·12 ,,
,, 7, ,, ...	0·12 ,,
,, 8, ,, ...	0·10 ,,
,, 9, ,, ...	0·11 ,,
,, 10, ,, ...	0·10 ,,
,, 11, ,, ...	0·11 ,,
,, 13, ,, ...	0·11 ,,
,, 14, ,, ...	0·11 ,,
,, 15, ,, ...	0·10 ,,
,, 16, ,, ...	0·12 ,,
,, 17, ,, ...	0·11 ,,
,, 18, ,, ...	0·15 ,,
,, 20, ,, ...	0·10 ,,
,, 21, ,, ...	0·11 ,,
,, 22, ,, ...	0·10 ,,
,, 23, ,, ...	0·11 ,,

Result of Experiments at Felling Chemical Works.

COMMUNICATED BY MESSRS. H. L. PATTINSON AND CO.

Jones's Furnace—	
O.V. used, on wet salt	78·00 per cent
,, real salt	85·80 ,,
Hand Furnace—	
O.V. used, on wet salt	82·00 ,,
,, real salt	90·00 ,,
Theoretical quantity—	
O.V. used, on wet salt	76·22 ,,
,, real salt	83·76 ,,

(Total foreign matter in the salt used, 9 per cent.)

The saving of O.V. in Jones's furnace over the hand furnace, as shown above, amounts on the real salt to 4·2 per cent.

In the course of the discussion Mr. Pattinson asked what the amount of hydrochloric acid was on an average in the chimney gases from the furnace, per cubic foot?

Mr. JONES replied that the tests were taken by their own chemist in the chimney. The grains per cubic foot of escape for the whole of November were something like this: 0·10, 0·11, 0·15, 0·10, 0·15. None of them exceeded 0·15.

Mr. MEASE asked how many tons of fuel there was put into the chimney per week, and how many tons of sulphate were worked.

Mr. JONES said they burnt about 250 tons of fuel per week altogether in the works; and as to the sulphates they produced from 110 to 120 tons per week. Dr. Angus Smith altered Mr. Todd's arrangement for taking the gases in the chimney, brought his own tube, and thrust it 5 feet into the chimney. He had worked it out with

his own hands; and stayed at the works for three days once for the purpose of testing personally.

On the question of the evolution of the gases, Mr. Mease said that one Saturday after the work had finished the water was stopped in the condenser, and he tested the strength of the acid for several hours; and for that time the strength of the acid kept up almost as strong as it was while the batch was working for some hours. It gradually got lower and lower. That pointed to this fact—that the amount of coke in the condenser holds a large amount of gas upwards; then the water coming down gradually washes down those gases, and in time the acid gets weak, showing that the strength of the acid at any particular moment is no criterion as to the amount of gas which is being evolved at that moment, on account of the large reserve of acid in the condenser.

Mr. Hill said that at the St. Bede Works they had turned out from 75 to 80 tons of the best sulphate of soda per week with great regularity, five and a half days in the week, and twenty-four hours a day, when decomposing common salt; and when working nitre cake and salt they could turn out nearly 100 tons a week.*

Mr. France thought he could add a little fact to the question of condensation. They had an ordinary decomposing furnace, such as is used on the Tyne—one doing, say 65 tons a week; and it went into a pair of 25 feet condensers, and then to the chimney. They never could succeed in getting the alkali down to one-fifth of a grain, the limit required by the Act; but when working Jones's furnace afterwards into the same pair of condensers, the gas at the outlet, before going into the chimney, never exceeded one-fifth of a grain. He might add, that having no use for the hydrochloric acid, they did not care how much water they put in. In each case an unlimited supply was put in.

Mr. H. L. Pattinson, Jun., said that in an ordinary decomposing furnace, if you kept the same feed on, and kept putting quantities of acid into it, you would naturally have an excess at one time and too little at another; but with Jones's furnace, owing to its coming off in a more regular way, this was not so, and they would get a greater condensation on the average.

Mr. Jones said, there was the question as to whether a sufficient output could be got from the furnaces. He thought this point had been most satisfatorily solved by Mr. Hill. He had seen two furnaces at work that day at the St. Bede Works, where they seemed to have hit the happy medium of getting a full amount of output from the furnace, combined with protection to the ironwork.

ACADEMIE DES SCIENCES DE ST. PETERSBURG.

M. Avenarius, "*On the Conditions Determining the Critical-Point.*" The author describes a series of experiments on the critical-point of ether conducted in an apparatus of his own design. The results lead to the conclusion that the critical-point is not occasioned by an equivalence of the specific volumes of liquid and vapour, according to the hitherto-received theory, but is to be expressed by the equation—

$$\frac{T}{p}\frac{dp}{dT} = 1,$$

where T = the absolute temperature, and p = the vapour-tension corresponding to this temperature.

O. Chwolson, "*On a Mercury Rheostat designed by H. von Jacobi.*" This somewhat complicated rheostat was completed by von Jacobi shortly before his death, and is here first described for the first time. It is especially adapted for such galvanometric investigations where it is important either to measure directly small resistances, or to follow accurately the minute changes in given resistances. Its leading features are easily attainable accuracy in the arrangement, minuteness of the recognisable and measurable resistances, unchangeability of the variable resistance in the course of time, possibility of removing during an experiment any increase of temperature in the variable resistance caused by the current, and ability to change the mercury forming the constant resistance after each experiment, thus avoiding the consequences of a rise in its temperature.

R. Lenz, "*On the Application of the Theory of the Division of the Galvanic Current to Decomposable Conductors.*" Experiments were made with solutions of sulphates of copper and of zinc, and the nitrates of copper and of silver in various degrees of concentration, the results of which, without exception, led to the conclusion that Kirchhoff's law for the bifurcation of the galvanic current in metallic conductors is equally applicable to liquid conductors.

G. Lawrinowitsch, "*On the Pinacon and Pinacolin derived from Methyl-Ethyl-Keton.*" Treatment of this keton with hydrogen *in statu nascendi* yields a pinacon with the formula $C_8H_{18}O_2$, which forms a white crystalline mass, and melts at 28°. Further treatment with dilute sulphuric acid changes into the corresponding pinacolin, $C_2H_5(CH_3)_2.C.CO.C_2H_5$, a mobile liquid possessing all the properties peculiar to tertiary ketons. The correctness of the formula was shown by oxidation, which yielded acetic acid and dimethyl-ethyl acetic acid, $C_2H_5(CH_3)_2C.COOH$.

NOTICES OF BOOKS.

Instruction in Photography. By Captain Abney, R.E., F.R.S., &c., Instructor in Chemistry and Photography at the School of Military Engineering, Chatham. Third Edition. London: Piper and Carter, 1876.

The fact of the first two editions of Captain Abney's excellent treatise having been absorbed in less than two years is a sufficient proof of the high estimation in which it is held, both by professional and amateur photographers. The chief merit of the work is its completeness as a working manual and the practical manner in which the various processes are described, the theoretical information contained in it being reduced within the smallest possible compass. A sketch of the way in which Captain Abney carries the learner through the collodion process will give an excellent idea of the manner in which the rest of the subject is treated. Beginning with the different descriptions of glass used in photography, and the best methods of cleaning them, the author proceeds to give the best formulæ of making pyroxyline and collodion, describing the properties of seven different kinds of iodisers and bromisers at great length, and explaining with great clearness the different purposes for which each particular kind of collodion is specially fitted, a species of knowledge which has hitherto received too little attention in works of this kind. The photographer no longer uses the same collodion in hot and cold, bright and foggy weather, or for portraits, landscapes, and copying as in the old days, but varies the kind of collodion and iodiser or bromiser according to the conditions under which he is working, and the class of subject he is engaged upon. We are glad to see that Captain Abney very properly condemns the practice of using methylated ether and alcohol as solvents for collodion. He next passes on to the sensitising-bath, which he describes somewhat briefly, and then gives a list of nearly a dozen different kinds of developers, minutely describing their peculiarities and the special purposes for which they are fitted. Intensifying next claims his attention, nearly a dozen solutions for increasing the thickness of the silver deposit, or for changing its colour to a more or less non-actinic hue, being given.

* The maximum output at the St. Bede Works from one Jones's furnace has been 103 tons in five and a half days working.

We do not remember having seen any manual in which these two important subjects have been treated of so fully as in the book before us. A number of formulæ for fixing solutions and varnishes being given, the various manipulations in wet-plate photography next receive the author's attention, practical details being entered into with great minuteness. A large portion of this section of the work is devoted to defects in negatives, their causes and remedies, and the professional or amateur who cannot get himself out of a "mess" by the aid of Captain Abney's instructions must indeed be unfortunate. This part of the book ends with an account of the nearly exploded positive wet process.

The various dry and emulsion processes, of which fourteen or fifteen are given, are then described, tea, coffee, beer, and stout (!) being among the preservatives mentioned. Surely there must be something very empirical about this branch of photography when such substances are used. The paper negative processes we should have thought were as obsolete as the daguerreotype; they are, however, described at length. Instantaneous pictures, photographing interiors, copying plans, transparencies, the reproduction of negatives, and paper enlargements are also very fully described. So far, the production of negatives on glass and paper. The positive printing process is then fully treated of, followed by directions for cutting, mounting, and rolling the finished prints, thus completing the first part of the work.

The second part describes the various processes for the more or less mechanical reproduction of positive prints by the autotype and powder processes, Woodbury type, heliotype, photo-lithography, zincography, &c.

The photographic enamelling process is well described, and seeing the ease with which it is carried out, and the beautiful and practically indestructible results obtained, it seems strange that it has not been more universally adopted by the professional photographer. Hints on apparatus, and a number of practical receipts and tables bring this excellent manual to a conclusion.

An exquisite little Woodbury type of a woodland scene in Windsor Forest from a negative by Captain Abney is given as a frontispiece, but the specimen of the photo-relief process (page 164) from the reproduction of woodcuts is a pitiful failure.

In his preface Captain Abney informs us that he is about to publish another Manual, to form part of Messrs. Longmans' "Text-Books of Science," which will enter much more fully into the theory of the subject; we shall await its appearance with great interest, such a work being much wanted.

CORRESPONDENCE.

DOCTORS' DIPLOMAS.

To the Editor of the Chemical News.

Sir,—I should like to call your attention to the following advertisement, which has for some time past appeared constantly in the Berlin *Kladderdatsch* :—

Doctor-Diplome jeder Facultät werden leicht und billig vermittelt.—Adr. Medicus, Royal Square, Jersey, England.

(Doctors' diplomas of every faculty easily and cheaply obtained.)

This advertisement, I fear, is doing much to give English degrees a bad odour in Germany. I think some of your countrymen should investigate the case, and if it be a swindle expose it.—I am, &c.,

Dr. P. Townsend Austen.

School of Mines, New York, U.S.A.

GRADUATION OF THERMOMETERS.

To the Editor of the Chemical News.

Sir,—Will any one of your readers kindly explain, through you, how thermometers, graduated as they now are, can indicate equal amounts of caloric. Should it be granted that both mercury and glass each expand with like quantities of caloric in their own equal proportions, it then follows that if the length of the tube of a thermometer, which is made of a material which is in no way changed by caloric, be from the freezing to the boiling-points of water, that is, from 32 to 212, which is 180°, divided into 1·00000000 parts, each degree will be in length 0·00555555, and that if the tube of such thermometers be made of glass, that then, as now graduated, the length of each degree will be 0·00555105, as in that case the amount of the expansion of the glass tube between the freezing- and the boiling-points of water, viz., 0·00081000, has first to be deducted, and then the difference has to be divided by 180°.

As the present usage is to graduate the entire thermometer with degrees, each of which is in length 0·00555105, any further expansion of the glass tube can in no way be indicated; and yet the length of the tube from the freezing- to the boiling-points is, with every additional 180° of caloric, equally expanded as it was with the first 180°, and ought to be indicated by the thermometer.

Should the range of a thermometer be 630°, the length of the glass tube of each of these degrees may be expanded 630 times; consequently the total number of expansions are 396,900, and as the total expansion of the glass tube between 32 and 212 is 0·00081000, it, when divided by 180 × 180, that is, by 32,400, gives 0·000000025 as the length of each expansion. Hence any degree multiplied by its own number from 32°, and the result of such multiplication by 0·000000025, always gives the entire length of the expansion of the tube from 32° to the degree sought; and this length, deducted from the sum of 0·00555555 multiplied by the number of the degree from 32°, gives the entire length of the tube from 32 to the degree sought. The difference between the length of the tube at any degree, say 211, and of it at that which precedes it, say 212, is the correct length of the graduation of the 212th degree; or the length of the graduation of any degree, say 212, may be obtained, thus, 180 × 2 − 1 × 2½ (or 0·000000025) − it from 0·00555555, remainder 0·005546575, which is the correct length of the graduation of degree 212.

The difference between the present graduation of a thermometer and what I consider to be the correct graduation of it is as follows :—

Correct Graduation.

Degree.	Length of Degree.	Length of Tube above 32°.
633	0·005525525	3·32985552
212	0·005546575	0·99918900
32	0·005555525	—

Present Graduation.

Degree.	Length of Degree.	Length of Tube above 32°.
632	0·005551050	3·33063000
	(More than 1 degree error.)	
212	0·005551050	0·99918900
32	0·005551050	—

Having for fifty years been convinced that thermometers, as now graduated, do not indicate the measure of the quantity of caloric, I now venture to seek an explanation of the ground on which they are considered to do so.—I am, &c.,

F. Parker.

Highgate, January, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 3, January 15, 1877.

Nature and Contagion of the Malady known as Typhoid Fever.—M. Bouillard.—A lengthy paper, not adapted for abstraction.

Experiments on the Coagulation of Fibrin.—M. A. Schmidt.—The author points out two species of animal liquids—the protoplastic, so called to distinguish them from the liquids which coagulate spontaneously, and which contain a ferment, and the fibrinogenous liquids.

The Phenomena of the Radiometer explained by the Aid of Pyro-electricity.—W. de Fonvielle.—It is known that pyro-electric phenomena are not merely manifested on the surface of certain crystals when submitted to a change of temperature. Every non-conductor if submitted to the action of luminous rays is heated, and becomes more or less strongly electric according to the nature and the intensity of the action. I believe that these considerations suffice to explain all the phenomena of the radiometer hitherto observed. The pyro-electricity developed by the passage of luminous rays through the glass is manifested merely in the interior and on the illuminated hemisphere, for the electricity liberated on the exterior is dispersed in the air, and produces no effect. On the other hand, the blackened discs being heated more strongly than the polished disks are more strongly electrified, and are therefore repelled more energetically. The motion must take place in the direction actually observed. If the radiometer is plunged into water we perceive that the glass of the capsule cannot be heated, that the interior surface is not in a condition to become electrified, and that consequently no electric reactions can take place. If the case of the radiometer is suspended by a thread we shall have, of course, a rotation in the direction opposite to that of the torsion apparatus, for the elementary actions being all equal, and in opposite directions, the two movements must consume exactly the same dynamic power. This is the essential character of all the reactions to which electricity gives rise. If the "mill" is immersed in air, or in a gas at the normal pressure, pyro-electricity can no more be developed in the interior of the case than on the outside: the movement of the "mill" therefore occurs in consequence of the decreased pressure of the gas upon the blackened disks, *i.e.*, in the inverse direction of the normal rotation. This normal movement is only produced as soon as the internal pressure of the case is so far diminished that electrisation can be developed by heat. It must cease when the vacuum is so perfect that the electric spark can no longer circulate, for them the reactions between the "mill" and the case can no longer be produced. The presence of a certain quantity of gas is therefore necessary, not as a mechanical propeller, but as a vehicle of electricity. The cessation of motion in a too perfect vacuum which appears to be established by decisive experiments is therefore explained without the aid of any new hypothesis on the internal constitution of gaseous bodies. All other conditions being equal, the radiometer will revolve the more rapidly the smaller the receiver, because the disks will be at a less distance from the electrised surface upon which they react, as Mr. Crookes seems to have established. If we suspend a disk of mica in the interior of the receiver, and above the "mill," its rotation will be explained like that which is produced in the air if we submit the same disk to the influence of an electrifying machine. The same forces will determine the movement in both cases, since the "mill" is charged by means of the light with electricity of tension comparable to that which is developed by the rotation of the plate of the machine. All considerations of a mechanical impulse due to the gas are superfluous. We thus understand why disks of mica should be more sensitive, other things being equal, than disks of aluminium, for it is well known that crystalline substances disengage pyro-electricity much more easily than metallic bodies more or less completely coated with isolating substances. It would be interesting to examine the same phenomena during the period of heating or cooling, with plates cut perpendicular to the crystallographic axis of bodies which, like tourmaline, possess axial pyro-electricity.

New Derivative of the Albuminoids.—M. P. Schützenberger.—The new compound is of a dull chalky white, and always crystallises in balls more or less voluminous. At 16° water dissolves 5·3 per cent, but at a higher temperature it is more soluble. It is insoluble in ether; sparingly soluble in cold alcohol at 90 per cent; rather more freely soluble in hot alcohol. If heated in the absence of air it melts between 245° and 250°, and is decomposed. Its elementary analysis leads to the formula $C_7H_{11}NO_2$.

Optical Properties of Mannite.—MM. A. Müntz and E. Aubin.—A reply to certain strictures of M. G. Bouchardat (Session of the Academy, January 3, 1877).

Action of Chloro-chromic Acid upon Organic Bodies.—M. A. Etard.—The author has examined the action of chloro-chromic acid upon certain hydrocarbons, especially toluen. One of the products obtained was chloride of benzyl.

Chemical Examination of the Mistletoe (*Viscum album*).—MM. Grandeau and Bouton.—The twigs of the mistletoe differ essentially in their chemical composition from those of the trees upon which it grows, but nevertheless vary with the latter. They contain more phosphoric acid and potassa than the trees, but less lime.

Detection of Magenta and other Analogous Colours in Wines.—M. A. Béchamp.—Not suitable for abstraction.

Justus Liebig's Annalen der Chemie, Band 184, Heft 1 and 2.

Behaviour of Palladium in the Flame of Alcohol.—F. Woehler.—The author finds that palladium is not capable of taking up ethylen gas or gases from the flame of alcohol, but that it determines the separation of carbon at a temperature at which ethylen gas is not alone decomposed.

Constitution of Ultramarine.—Julius Philipp.—Not suitable for abstraction.

Certain Derivatives of Desoxybenzoin.—A. Zagoumenny.—The author has examined the action of alkalies dissolved in certain primary and secondary alcohols upon desoxybenzoin.

Formation of Diphenyl-carbinol, and on certain of its Derivatives.—A. Zagoumenny.—Benzophenon dissolved in an alcoholic solution of potassa is converted into diphenyl-carbinol on boiling with zinc.

Action of Nitric Acid upon Tri-brom-phloro-glucin.—Dr. R. Benedict.—Amongst the substances formed are bromopicrin and oxalic acid.

Reimann's Farber Zeitung.
Nos. 43 and 44, 1876.

These numbers contain nothing of general interest.

No. 45, 1876.

Dr. Walz has discovered vanadium in the magnetic iron ores of America, sometimes in not insignificant quantities. Blake has found vanadium in the mica of California and König in the magnetic iron ores of Arkansas.

No. 46, 1876.

This issue contains nothing of interest.

MEETINGS FOR THE WEEK.

SATURDAY, Feb. 3rd. Physical, 3. Annual General Meeting; Election of Officers, Council, and Honorary Members. "On Vortex Motion," by Prof. Osborne Reynolds. "On Apparatus to Illustrate Wave Motion," by C. J. Woodward, B.Sc.

MONDAY, 5th.—London Institution, 4.
—— Medical, 8.
—— Royal Institution, 3. General Monthly Meeting.

TUESDAY, 6th.—Royal Institution, 3. Prof. Tyndall, "On the Truman Formation, and Structure in Relation to its Contour."
—— Civil Engineers, 8.
—— Zoological, 8.

WEDNESDAY, 7th. Society of Arts, 8. "Street Tramways," by Capt. Douglas Galton, C.B.
—— Geological, 8.
—— Meteorological, 8. (Anniversary).
—— Pharmaceutical, 8.

THURSDAY, 8th.—Royal, 8.30.
—— London Institution, 7.
—— Royal Institution, 3. Dr. Wright, "On Metals and the Chief Industrial Uses of these Bodies and their Compounds."
—— Society of Arts, 8. (Chemical Section). "Some Processes of Nature's Hygiene (Improvements in the Production of Antiseptics, Disinfectants, and Blood Albumen)," by C. T. Kingzett, F.C.S.

FRIDAY, 9th.—Royal Institution, 9. "Typical Laws of Heredity," by F. Galton.
—— Astronomical, 3. (Anniversary).
—— Quekett Club, 8.

SATURDAY, 10th.—Royal Institution, 3. "Florence and the Medici," by J. A. Symonds.

TO CORRESPONDENTS.

Dr. R. Carter Moffat.—Will this gentleman kindly forward his present address to our office.

P. Macintyre.—Mr. Bowditch and Mr. Sugg have both written books on the subject.

S.—It is given in most books on commercial analysis. See Crookes's "Select Methods in Chemical Analysis."

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By THOMAS RICHARDSON and HENRY WATTS. Second Edition, illustrated with numerous Wood Engravings.

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THE CHEMICAL NEWS

Vol. XXXV. No. 898.

ON THE QUANTITATIVE DETERMINATION OF NITRIC ACID BY INDIGO.

By ROBERT WARINGTON.

(Concluded from p. 47).

V. *Influence of Dilution on the amount of Indigo required.*

For a volumetric method to admit of easy and satisfactory use it is necessary that the substance sought, whether in a dilute or strong solution, should always correspond to the same quantity of the reagent employed: the evidence before me leads me to doubt if this is altogether the case in the present method. The question is not an easy one to decide, for to do this demands absolute freedom of the oil of vitriol from oxidising or reducing substances. As the volume of oil of vitriol employed is little affected whether a dilute or strong solution of nitrate is operated on,—indeed remains unchanged if the indigo solution be diluted equally with the nitrate,—the proportion of the sulphuric acid to the nitre will vary inversely with the quantity of the latter present. It follows that if the oil of vitriol contain nitrous impurities, possessing an oxidising power, halving the strength of the nitrate solution will not halve the indigo required, but an increased proportion of indigo will be demanded per unit of nitre. On the other hand, if the oil of vitriol contain sulphurous acid, or other reducing matter, the effect will be in the contrary direction, and a smaller quantity of nitre will require a diminished proportion of indigo. Should the strength of the nitrate solution be increased instead of diminished, the errors will be in contrary directions. As the proportion of oil of vitriol employed is always very large in relation to the nitrate present, traces of impurity in the oil of vitriol are able to produce sensible effects. Before describing the results obtained it will be well to mention the precautions taken with regard to the oil of vitriol used in these experiments.

The acid was purchased as pure distilled oil of vitriol; it had, however, a scarcely perceptible smell of sulphurous acid, and was not absolutely free from colour. When the acid was violently shaken in a half-filled bottle, and the atmosphere of the bottle tested for sulphurous acid with iodine paper, after the method I have elsewhere described (Chem. News, xvii., 75), the presence of this acid was plainly manifested. This oil of vitriol was purified by heating for six hours, to near its boiling-point, in a capacious flask freely open to the air. It then became absolutely colourless, and the iodine-test failed to reveal the presence of sulphurous acid. This was the acid employed in the following experiments. As, however, the results obtained by its use might be partly explained by assuming the presence of a small quantity of reducing matter, a portion of the purified acid was subjected to further treatment. To 1 litre of the acid was added 1 grm. of nitrate of ammonium, and the whole heated to near boiling for several hours. The acid was then strongly nitrous, and in a blank experiment destroyed a considerable amount of indigo. It was presumed that all reducing matter must now be destroyed. Some crystals of pure oxalate of ammonium were next dissolved in the acid, and heating resumed. In about an hour all nitrous compounds had disappeared. The acid was then brought to its boiling-point, and boiling continued for two or three hours. The acid thus prepared gave exactly the same results as before treatment with nitrate of ammonium. In order to confirm this result, the removal of all reducing matter was further attempted by a second method. To 1 litre of the purified acid were added 5 grms. of peroxide of manganese, and the whole heated to near boiling till the manganese was dissolved. On cooling, the sulphate of manganese crystallised out. The acid was decanted off, and used for experiments with indigo: the results were similar to those before obtained. I conclude, therefore, that the oil of vitriol employed was free from reducing substances.

The following table shows the number of cubic centimetres of indigo solution required by 10 c.c. of three solutions of nitre, containing respectively 0·01011 grm., 0·005055 grm., and 0·0025275 grm. of nitre. Each nitre solution was tried with four proportions of oil of vitriol.

	Normal Nitre Solution.	Half Strength Nitre.	Quarter Strength Nitre.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo
	c.c.	c.c.	c.c.	
Indigo required in experiment ..	11·30	5·70	2·85	1
Dif. from calculation	—	+0·05	+0·025	
Indigo required ..	10·40	5·15	2·50	1½
Dif. from calculation	—	−0·05	−0·10	
Indigo required ..	9·75	4·75	2·30	1½
Dif. from calculation	—	−0·125	−0·138	
Indigo required ..	8·90	4·20	1·90	2
Dif. from calculation	—	−0·25	−0·325	

Two other series of experiments may be quoted; in these, after determining the relation of the indigo solution to the nitre, both solutions were diluted to four times their volume, and again tried against each other. It is evident that if dilution does not disturb the relation of indigo to nitrates the same volume of indigo should be required in the second trials as in the first. The following table shows the number of cubic centimetres of indigo required in each case.

	Normal Nitre and Indigo.	Quarter Strength Nitre and Indigo.	Difference.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo.
	c.c.	c.c.	c.c.	
Indigo required ..	11·50	11·70	+0·20	1
,, ,, ..	9·80	9·40	−0·40	1½
,, ,, ..	8·85	7·50	−1·35	2

The acid purified with manganese was tried with normal and quarter strength solutions, as just described, a different indigo being used from that employed in the last-quoted experiments. The results were as follows:—

	Normal Nitre and Indigo.	Quarter Strength Nitre and Indigo.	Difference.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo.
	c.c.	c.c.	c.c.	
Indigo required ..	11·10	11·30	+0·20	1
,, ,, ..	8·15	7·40	−0·75	2

As, however, the acid contained a trace of oxidising matter (as shown by a blank experiment with indigo), the "difference" in the case of 1 volume of oil of vitriol will be less, and in the case of 2 volumes greater, than here stated,

Many other similar experiments have been made; they all point to the same conclusion as those here quoted. It appears that when 1 volume of oil of vitriol is employed dilution of the nitre does not greatly disturb its relation to the indigo, and that the tendency under such circumstances is for nitre diluted to take a little more indigo than nitre concentrated. When 1½ volume of oil of vitriol is employed the error becomes distinct in the opposite direction. When 2 volumes are used the error becomes very considerable, nitre diluted taking decidedly less indigo than nitre concentrated. In fact, taking the figures of the first table, if the indigo had been stan-

dardised with a normal nitre solution, and the solution to be analysed had contained only one-quarter this proportion of nitre, the result reported would have been 14·5 per cent below the truth,

The experiments certainly show that every operator must ascertain for himself, with his own reagents, whether differing volumes of indigo really correspond with similar differences in nitric acid.

VI. *The Influence of Chlorides.*

According to Marx, chlorides have no influence on the reaction: the same statement is made by Sutton, limited, however, to the chlorides present in waters. I have made a few experiments in which from 0·03 to 0·10 grm. of chloride of sodium was added to 10 c.c. of nitre solution: the result in every case was a small, but distinct, diminution of the quantity of indigo required. The mean of four fairly agreeing experiments with a nitre solution of normal strength showed that 100 parts of chloride of sodium had a reducing effect equivalent to 1·16 of nitrate of potassium.

When a sufficient amount of chloride is present the series of tints is entirely changed, the colour varying from gold to bright green: in the above experiments the first distinct shade of green was taken as the final reaction. When only a little chloride is present the first green colour is obtained by dilution, as already described.

The addition of a sufficient amount of common salt practically changes the conditions to those occurring in Boussingault's method. The final tint is green in both cases: experiment also showed that the same weight of nitre requires considerably less indigo when heated with hydrochloric acid than when mixed with sulphuric acid, 10 c.c. of nitre solution required 6·9 c.c. of indigo when treated by Boussingault's method, but 9·6 c.c. of the same indigo was needed when the experiment was repeated with 2 volumes of oil of vitriol. This is a direct confirmation of the statement just made, that chlorides tend to reduce the amount of indigo required.

VII. *The Influence of Organic Matter.*

It will be recollected that Boussingault found that certain kinds of organic matter had a very prejudicial effect, the nitric acid attacking these as well as the indigo, and thus seriously reducing the amount of indigo oxidised. It was important to ascertain whether the same effect would take place in the sulphuric acid method; experiments were therefore made with cane-sugar, using both weak and strong solutions of nitre, and various proportions of oil of vitriol. The results were as follows:—

Nitre, Normal Strength.	Cane-Sugar.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo.	Indigo required.	Reducing Effect of 100 of Sugar expressed in Nitre.
10 c.c.	None	1	13·7 c.c.	—
10 ,,	0·01 grm.	1	12·7 ,,	7·4
10 ,,	None	2	11·1 ,,	—
10 ,,	0·01 grm.	2	8·7 ,,	21·8

The next experiments were with a different indigo solution: both the nitre and indigo solution were diluted to one-tenth their usual strength.

Nitre, one-tenth Normal.	Cane-Sugar.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo.	Indigo required.	Reducing Effect of 100 of Sugar expressed in Nitre.
10 c.c.	None	1	12·9 c.c.	—
10 ,,	0·001 grm.	1	9·2 ,,	29·6
10 ,,	None	2	7·8 ,,	—
10 ,,	0·001 grm.	2	3·0 ,,	62·3

The reducing effect of the sugar is seen to be in all cases very considerable; it is much greater when 2 vols. of oil of vitriol are employed than when only 1 volume is used; it is also much greater in dilute than in strong solutions. The reason of the greater effect in weak solutions is probably the longer time available for the reaction. With a normal nitre solution the reaction with the indigo is practically over as soon as mixing is completed, but with a one-tenth normal solution the reaction will take more than half a minute. It is unfortunate that under the special conditions of water analysis organic matter will produce its greatest effect.

The object of the present investigation being to ascertain if the indigo method could be employed for determining nitrates in soil extracts, and in drainage waters, it was important to ascertain if the particular kinds of organic matter there present had a prejudicial effect. A kitchen-garden soil, rich in organic matter, was taken for the experiment. The nitrates in this soil had been previously determined by the mercury method employed by Frankland for water analysis; it was therefore possible, by calculation, to prepare an extract which should be of nearly the same strength as the normal nitre solution with which the indigo had been standardised; all errors of dilution were thus avoided, and the indigo method tried under the most favourable circumstances. As an example of an analysis by the indigo method, I will give the details of the experiment.

The watery extract from 60 grms. of air-dried soil was brought to 100 c.c.; the solution was amber-coloured, and slightly turbid. Successive experiments were made with 10 c.c. of this solution, till the maximum amount of indigo it required was ascertained. The indigo was in the first experiment run from a burette into the mixture of sulphuric acid and soil extract, but in the final trials the indigo was all added before the oil of vitriol. The proportion of oil of vitriol used after the preliminary trial was uniformly 1 volume.

Soil Extract.	Indigo added before Oil of Vitriol.	Oil of Vitriol.	Indigo added after Oil of Vitriol.	Total Indigo used.
10 c.c.	None	25·0 c.c.	10·4 c.c.	10·4 c.c.
10 ,,	11·4 c.c.	21·4 ,,	0·6 ,,	12·0 ,,
10 ,,	12·0 ,,	22·0 ,,	0·5 ,,	12·5 ,,
10 ,,	12·6 ,,	22·6 ,,	0·1 ,,	12·7 ,,
10 ,,	12·7 ,,	22·7 ,,	—	12·7 ,,
10 ,,	12·9 ,,	22·9 ,,	—	12·9 ,,
10 ,,	13·0 ,,	23·0 ,,	—	13·0 ,,

The maximum amount of indigo was reached when 13·0 c.c. were added.* A second extract of the soil residue required in all 1·0 c.c. of indigo. The nitrates in 6 grms. of soil were thus equivalent to 13·1 c.c. of indigo.

10 c.c. of nitrate solution, containing 0·010104 grm. of nitrate of potassium, required 13·6 c.c. of indigo, when 23·6 c.c. of oil of vitriol were employed. The percentage of nitrogen as nitrates in the soil was by calculation from these data 0·02246. The mean of two determinations by the mercury method gave 0·02224 per cent.

Another surface soil, analysed by the two methods, gave equally agreeing results. It appears, therefore, that the organic matter present in soil extracts, and probably therefore in drainage waters, has no appreciable effect on the result when the solution operated on is sufficiently concentrated, and when a minimum proportion of sulphuric acid is employed. A large series of soils and waters must, however, be examined by different methods before the results obtained with indigo can be considered as fully trustworthy.

In conclusion we will make a few remarks on the bearing of some of the facts now described upon the practical conduct of the method.

It is evident that results obtained by merely running indigo from a burette into a mixture of nitrate and sulphuric acid (the method of Marx, Trommsdorff, and Goppelsroeder) can only be exact under very exceptional

* This result might have been obtained in fewer experiments by greater boldness in the operator.

circumstances, and that to obtain constant results it is indispensable that all the indigo be present before addition of the oil of vitriol. It is also evident that the volume of oil of vitriol used must always bear the same proportion to the united volumes of nitre and indigo solution as in the experiment in which the indigo solution was standardised. When we come to the question, What is the best proportion of oil of vitriol to adopt? the answer becomes more difficult.

The various writers on the subject, from Marx to Sutton, all recommend the use of a double volume of oil of vitriol, without, however, offering any specific reason for the choice. We have seen that with this large proportion of sulphuric acid the errors caused, both by organic impurities, and by impurities in the acid itself, are at their maximum; evidence has also been adduced to show that with this proportion of acid the indigo scale has not the same value in every part. The use of a single volume of acid is free from the above objections; the bulk of indigo consumed is also much larger, and the range of tint in the final reaction is very short and good. The results are, however, much more dependent on manipulation, and to some extent on external temperature, than those obtained with greater volumes of acid; it is also essential in this case that the acid shall be of full gravity.

If only 1 volume of sulphuric acid is to be employed, it will suffice for most purposes to ascertain the freedom of the acid from nitrous and sulphurous impurities; acid sold as pure distilled oil of vitriol frequently contains one or other of these contaminations, and sometimes both. Nitrous impurity is easily tested for with indigo, the acid being mixed with distilled water. If the acid is mixed with water in the same proportions as will be used in subsequent experiments, the amount of indigo oxidised by a given volume of acid under these circumstances may be determined, and a correction subsequently made in every experiment, according to the volume of acid employed. If the acid oxidises indigo, the nitrous impurity is plainly in excess of the sulphurous, and the analyst need go no further. If the acid does not oxidise indigo, sulphurous acid must be looked for: this is best done by the test previously described (page 57). The methods of purifying oil of vitriol from sulphurous and nitrous acid have been already noticed.

If 2 volumes of sulphuric acid are to be used, all tests for impurity may be dispensed with, for a series of experiments must be made as to the value of different parts of the indigo scale; and these determinations will include all the errors introduced by the acid, if the same volume of nitrate solution be always employed. The experiments on the value of different parts of the scale are conveniently made by diluting the normal nitre solution to one-half, one-quarter, and one-eighth its original strength, and then ascertaining the amount of indigo required by the same volume of these various dilutions. These experiments must be renewed every time a fresh bulk of oil of vitriol is taken into use.

There is, however, one mode of proceeding by which the operator may become entirely independent both of impurities in the oil of vitriol and variations in the indigo scale. If the liquid to be analysed is concentrated or diluted till 10 c.c. require exactly the same quantity of indigo as 10 c.c. of any known nitre solution, it is evident that both solutions must contain the same quantity of nitrate, whatever may be the impurities in the oil of vitriol employed in both experiments.

New Colouring Matter Derived from Cresylol.—M. J. Annaheim.—If 100 grms. of cresylol from wood-tar, boiling about 202°, are heated with 40 grms. of fuming sulphuric acid for several hours to 100°, or rather to 120° to 130°, the product formed dissolves in acetic acid with a magenta colour. In alkalies it dissolves with a greenish blue colour, which quickly disappears.—*Les Mondes.*

A NEW AND ACCURATE METHOD FOR DETERMINING BOILING-POINTS WITH SMALL QUANTITIES OF LIQUID.

By P. T. MAIN.

By the boiling-point of a substance is meant the temperature at which the tension of its vapour is equal to the atmospheric pressure at the level of the liquid: the boiling-point of a given substance is thus a variable temperature, depending on the varying atmospheric pressure. In defining bodies by their physical characters it is usual to state these characters, when possible, with reference to standard conditions of pressure and temperature; thus a body is defined by its specific gravity and specific heat at a standard temperature, and by its boiling-point at a standard pressure. From this point of view we may define the boiling-point of a liquid as the temperature at which the tension of its vapour is equivalent to a pressure of 760 m.m. of mercury at 0° C. The problem of determining the boiling-point of a liquid resolves itself therefore into two problems:—(1), to make the tension of its vapour = 760 m.m.; (2), to determine the temperature at which it has this tension. Of these problems I have attempted a solution by a method which is, so far as I am aware, new, and which is susceptible—with an accurate barometer and a sufficiently delicate thermometer—of great accuracy with quite small quantities of liquid. My apparatus for this purpose consists of two principal parts—a boiling-tube and a pressure-tube. The boiling-tube is a thin, narrow, glass tube, V-shaped, hermetically sealed at its short end, and open at the long end; the short end may be about 2 inches in length, the long end about 18 inches: these dimensions I have found convenient in practice. The pressure-tube is a vertical glass tube, which can be connected with the open limb of the boiling-tube by a drying-tube, and which dips into water contained in a wider glass tube: by raising or lowering this wider tube, the pressure within the open limb of the boiling-tube may be made greater or less than the atmospheric pressure. The boiling-tube is held so that the bend of it is its lowest point: in this position the liquid to be operated on is distilled or poured into it in such quantity that on inclining the tube the air in the closed limb may be displaced by the liquid, which may be made to occupy the whole of this limb and a small portion of the open limb. By boiling this portion of liquid in the tube sufficiently, all dissolved air or gases may in general be expelled from the liquid, the space above which in the closed limb is then occupied by the vapour of the liquid only. The boiling-point of the liquid must be known or determined first approximately, which is easily done by a preliminary experiment; and we can then determine it accurately (if it is less than that of water) by immersing the boiling-tube in water at a temperature a little higher than the boiling-point of the liquid, connecting it with the pressure-tube, and increasing or diminishing the pressure by means of this so as to make it exactly equal to that of 760 m.m. of mercury at 0° C. By carefully lowering the temperature of the water till the liquid in the boiling-tube stands at exactly the same level in both limbs, and taking a few observations of the temperature while the liquid is steady in the boiling-tube or oscillating slowly about this mean position, it is possible to determine the boiling-point at 760 m.m., with considerable accuracy, with so little as 1 c.c. of liquid.

For liquids whose boiling-points are higher than that of water the process would necessitate the use of dense aqueous solutions, or of some other liquid which can be heated to higher temperatures than water without boiling or decomposing.

At present I have applied this method only to liquids whose boiling-points are lower than that of water.

I append the results of experiments on the following liquids:—Ether, chloroform, alcohol, tetrachloride of carbon, all of which were nearly pure to start with.

Ether.—Purified from water and alcohol by sodium till effervescence ceased; boiling-point, 34·8°.

Chloroform.—Purified from traces of water and alcohol by boiling with sodium till all action had ceased; boiling-points, 61·1 to 61·2. These boiling-points were given by two portions, about 1 c.c. each, taken respectively from near the beginning and near the end of the distillate from 80 c.c. of chloroform purified by sodium. On two previous occasions portions of about 12 c.c. were taken and purified with sodium, and the boiling-point of the first distillate—about 2 c.c.—from each was found to be 61·15. On another occasion the boiling-point of a portion of the undistilled and unpurified chloroform was found to be 61·3°; and again, 100 c.c. of the chloroform, before purification by sodium, were distilled, and portions—about 2 c.c. each—from the first, middle, and last portions of the distillate, gave respectively 61·1°, 61·2°, 61·5° as the boiling-points.

Alcohol (absolute) gave boiling-point 78·05°; after purification from traces of water by sodium, boiling-point 78°; again, a portion—about 130 c.c.—purified by quicklime gave as the boiling-points of portions from the beginning, middle, and end of the distillate, 78·1° in each case.

Tetrachloride of Carbon, unpurified and undistilled, gave boiling-point 76·3°; a first portion—about 3 c.c.—distilled from about 110 c.c. gave boiling-point 76·25°; a last portion from the same gave boiling-point 76·5°; again, about 15 c.c. were purified from traces of water and alcohol by boiling with sodium, and distilled; about 4 c.c. were taken of the first distillate, and gave boiling-point 76·5°; about the same quantity at the very end of the distillation gave boiling-point 76·6°.

Where I was uncertain about the reading of the thermometer—as, *e.g.*, whether it was 76·2° or 76·3°—I put it down as 76·25; but my thermometer was not divided so widely as to give exact readings to within less than 0·1° C.

The above determinations are, I believe, nearly exact, but my object in giving them is not to put them forward as accurate results, but as indicating, by the closeness with which they agree with each other for the same nearly pure liquid, the degree of accuracy which may be expected from the method when it is more matured.

At the present I have sufficient confidence in my results to say that the boiling-points are not in error by so much as three-tenths of a degree centigrade; and that, if there is an error of more than one-tenth of a degree, it is due not to any imperfection of the method, but to inaccuracy in the reading of the thermometer or of the barometer.

I hope before long to make some fresh determinations with more delicate thermometers.

The usual method for determining boiling-points is incapable of giving accurate results, for this reason—that it is impossible to secure that the vapour-tension of the liquid at the temperature observed differs from the atmospheric pressure at the level of the liquid by an inappreciable amount only. By my method it is quite possible, and not very difficult, to secure the fulfilment of this all-important condition.

St. John's College, Cambridge,
January 18, 1877.

THE PHILOSOPHICAL SOCIETY OF GLASGOW AND THE AMENDMENT OF THE LAW ON PATENTS FOR INVENTIONS.

THE Philosophical Society of Glasgow appears to have given very careful and prolonged attention both to the existing state of the Patent Law in Great Britain and Ireland, and to the proposals made during the last two sessions of Parliament for their amendment. The result of their deliberations has been the unanimous adoption of a memorial to the Lord Chancellor and a petition to both Houses of Parliament, for a copy of which we are indebted to the courtesy of Sir William Thomson.

We need scarcely say that a body like the Philosophical Society of Glasgow, comprising, as it does, numbers of eminent practical men, is very far from approving of the principles of the Bills of the last two sessions, almost avowedly designed to repress invention. The petitioners, though they pronounce no formal condemnation of these abortive measures, evidently hold that invention ought to be fostered, and that the rights of inventors to their own ideas should be fully recognised. They insist that the present scale of charges and fees is too heavy; they consider that the term of letters patent should be extended to at least twenty-one years, the present term of fourteen years being "too short for the development of by far the most important inventions or for the remuneration of the inventors." With this proposal we heartily concur, especially on account of its contrast with the clause of the Bill of last session, which gravely proposed that if a patent had not come into operation "on a reasonable scale" within two years, it should be regarded as void. Every practical man knows that except the patentee is a capitalist it is very rarely indeed that a new invention can be got into operation so early as the second year.

The petition before us does not take exception to the appointment of a Board of Examiners, but would not vest them with the power of rejecting applications. It is further proposed to abolish the "notice to proceed" as a mere costly and useless formality; to extend the time of payment of taxes "by allowing a certain period of grace within which they may be paid," and to maintain the present system of "Provisional Protection," which the measure of last year sought to abolish.

We think that the Glasgow Philosophical Society deserves great credit for having adopted this petition, and we hope that the example will be generally followed by similar bodies throughout the United Kingdom.

One point has possibly been overlooked. An English patent, under the "old law," extended to all the Sovereign's, "colonies, and plantations abroad," but not to Scotland and Ireland. The present law did away with the necessity of taking out three separate patents for England, Scotland, and Ireland, but by a most unfortunate blunder the colonies were omitted. Hence to protect an invention over the whole British empire costs at present above a thousand pounds sterling. We think that the amended Patent Law, if one is enacted, should at least take in India and all those colonies which have not separate legislatures of their own.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 1st, 1877.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed, the following names were read for the first time:—Messrs. E. Hunter, F. C. C. Hewett, W. Terrill, A. Kinninmont, J. Borland, W. H. Griffiths, and G. A. C. Pearce. Messrs. Arthur Gaved Phillips and Ferdinand Kopfer were duly elected Fellows, after their names had been read the third time.

The PRESIDENT then gave notice that it was intended that the Fellows should dine together on March 20, and that they would shortly receive invitations. After the Anniversary Meeting a Special General Meeting would be held to consider the regulations for admission to the Associateship of the Society, and also an alteration in the form of obligation which the Fellows had to sign on entering.

The first paper was by Dr. H. E. Armstrong, "*On Kekulé's and Ladenburg's Benzene Symbols.*" The speaker, after pointing out that although Kekulé's symbol had been used almost exclusively up to the present time, Ladenburg's "prism" formula merited more consideration than it had hitherto received, said that these two symbols were in accord in representing benzene as a symmetrical compound, *i.e.*, in which the six hydrogen atoms were of equal value. This consideration was supported, not only by the fact that no isomeric mono-derivatives of benzene had ever been obtained, but also by direct experimental evidence; for whichever hydrogen atom in benzene is displaced by the group OH, we always obtain the same phenol, as shown in the decomposition of the different oxy-benzoic acids and similar reactions. With regard to the di-derivatives of benzene, there is no ground for supposing that more than three isomeric forms can exist, and in this respect, also, the two symbols are identical with regard to the number of such isomerides which they indicate. It has been urged that one of the chief reasons for the adoption of Kekulé's symbol is that the formation of additive compounds is readily explained on the supposition that, when a molecule of a halogen unites with benzene, two adjacent carbon atoms united by a double affinity each unite with an atom of halogen, and thus remain united to one another only by a single affinity. Ladenburg's prism formula, however, lends itself to a similar explanation, with this difference, that it is the opposite carbon atoms in the ring previously united by a single affinity which unite each with a single atom of halogen, and at the same time cease to be directly united. After some observations on the difficulty of explaining the nature of the quinons, and on the influence a group exercises on others occupying the ortho or para position relatively to it, which could not be satisfactorily accounted for by the use of Kekulé's symbol, whilst Ladenburg's prism formula offered a possible explanation, the speaker expressed his opinion that the term para as applied to the di-derivatives of benzene should be limited to those which were capable of yielding but a single tri-derivative, whilst those which gave rise to two and three isomeric tri-derivatives should be called ortho- and meta-derivatives respectively. This nomenclature, being founded on experiment, was independent of any theoretical considerations as to the so-called "position" of the substituted groups. At present, although all known facts are in accordance with the supposition that the six carbon atoms in benzene and its derivatives are united in a closed chain, we do not in the least know in what manner the atoms are united: for this reason the simple hexagon now almost universally employed to represent benzene was preferable to the graphic formula consisting of six C's united in a hexagon by single and double lines alternately.

The President said they were all much indebted to Dr. Armstrong for the lucid manner in which he had discussed the relative value of the two graphic representations of benzene employed by Kekulé and by Ladenburg.

Dr. Odling said that it was the custom of the Society not to publish communications of a purely theoretical character, but he hoped that in this instance the Publication Committee might be induced to depart from the rule, so that they might have the benefit of perusing Dr. Armstrong's useful *resumé* in the Society's *Journal*. He quite agreed with the speaker that the evidence was overwhelming as to the existence of but a single mono-derivative of benzene of each kind; also in rejecting that form of expression for quinons which represented them as containing oxygen united with oxygen. It was in the highest degree improbable that this could be the case, considering how totally different they were from those bodies which, like the peroxides, were supposed to contain oxygen united with oxygen. With regard to the employment of the symbols 1 : 2, 1 : 3, &c., he thought them preferable to the terms ortho, meta, and para, as these were employed in very different senses; Körner, for instance, who might be regarded as the most prominent representative of aromatic chemistry, used them in a very different sense from that in which they were ordinarily regarded. Moreover, there were numerous benzene compounds which at one time had been regarded as ortho and were now considered para or meta, and the same might be said of bodies formerly regarded as para or meta. For his own part he was in the habit of associating the various di-derivatives with the typical compounds, resorcin, pyrocatechin, and hydroquinon; for instance, those which could be converted into or were related to resorcin he distinguised by the prefix reso-, and so on.

Dr. Wright thought they onght all to be thankful to Dr. Armstrong for the trouble he had taken in collating facts relative to these two symbols. There was an objection to the use of the terms meta and ortho in connection with the benzene derivative, inasmuch as they had long ago been applied to distinguish two of the phosphoric acids, the meta- being obtained from the ortho-acid by the abstraction of water, but nothing of the kind occurred in the case of the benzene compounds. He quite agreed with the speaker that these symbols should not be taken to represent any relative position of the atoms in benzene.

Dr. Odling said he might perhaps be permitted to remark that the term meta was first used by Graham to indicate that meta-phosphoric acid still contained water, phosphoric anhydride being at that time regarded as the true acid; and he had advocated the view that those acids which had the full amount of base or basic water should receive the prefix ortho.

Mr. Kingzett made some remarks on the benzene ring. He agreed with the view advocated by Dr. Armstrong that the six carbon atoms were united so as to form a closed chain. This afforded a means of explaining the different behaviour of phenose, $C_6H_6(OH)_6$, from that of the sugars, of which there were many having the same empirical formula $C_6H_6(OH)_6$. He had found that in certain reactions acetic acid could be substituted for sugar, and it was worthy of notice that if the formula of acetic acid, $C_2H_4O_2$, be tripled it is the same as that of sugar, $C_6H_{12}O_6$.

Dr. Armstrong, in reply to a question put by Dr. Odling as to the difference in solubility in alcohol between ordinary potassic benzoate and that recently prepared by the action of alcoholic potash on benzoic aldehyd, first observed by Gregory, said that he did not know of any explanation of the fact. He also cautioned Mr. Kingzett against hastily drawing conclusions from the supposed constitution of phenose, as it was not by any means satisfactorily established that it had the formula assigned to it by Carius.

The next paper was by Mr. W. H. Perkin, "*On the Formation of Coumarin, and of Cinnamic, and of other Analogous Acids from the Aromatic Aldehyds.*" The author, after adverting to a preliminary notice on the subject read before the Society in 1875, gave a brief account of some of the numerous substances he had obtained. He found that on boiling benzoic aldehyd with acetic anhydride and sodium acetate an action took place, with formation of an acid, which after purification was found to be identical with cinnamic acid. When sodium propionate and propionic anhydride were substituted for the acetate, *phenyl-crotonic acid*, $C_6H_5.C_3H_4.COOH$, was obtained. It crystallises in fine colourless needles, which melt at 82° to 84° C. *Phenyl-angelic acid*, $C_6H_5.C_4H_6.COOH$, was prepared in a similar manner by the employment of butyric anhydride. It crystallises in needles, which melt at 101° C. With succinic anhydride an acid was obtained having the same composition as phenyl-crotonic acid, but very different in properties; it has been named *isophenyl-crotonic acid*. Experiments were made in a similar manner with other aldehyds, namely, cuminic, cinnamic, anisic, and methyl-salicylic, which gave rise to sixteen other acids. It was found that the calcium salt of cumenyl-acrylic acid, obtained from acetic anhydride and cuminic aldehyd, when heated to 90° to 100° C., absorbed an atom of oxygen, and was converted into the calcium

salt of a new acid, which is now under investigation. Cumenyl-acrylic acid, also, when treated with sodium amalgam in the presence of water, takes up a molecule of hydrogen, giving rise to a crystallisable *hydro-cumenyl-acrylic acid*, which melts at 70° C. Cumenyl-acrylic acid when gently boiled undergoes decomposition, carbonic anhydride is eliminated, and a hydrocarbon,—

$$C_6H_4(C_3H_7)(C_2H_3)$$

isopropyl-vinyl-benzene, is formed. It is an oil boiling at 195° to 200°, and possessing a fragrant aromatic odour. The *methyl-para-oxy-phenyl-crotonic acid*, obtained from anisic aldehyd and propionic anhydride, under similar circumstances gave rise to anethol, $C_6H_4(OCH_3)(C_3H_5)$, whilst the corresponding acrylic and angelic acids gave rise to the homologous compounds, $C_6H_4(OCH_3)(C_2H_3)$ and $C_6H_4(OCH_3)(C_4H_7)$. By treating methyl-salicylic aldehyd with acetic, propionic, and butyric anhydrides, respectively, in presence of the corresponding sodium compounds, three acids were obtained, namely, *methyl-orthoxy-phenyl-acrylic acid*, or *methyl-coumaric acid*,—

$$C_6H_4(OCH_3)C_2H_2.COOH;$$

methyl-orthoxyphenyl-crotonic acid,—

$$C_6H_4(OCH_3)C_3H_4.COOH;$$

and *methyl-orthoxyphenyl-angelic acid*,—

$$C_6H_4(OCH_3)C_4H_6.COOH.$$

The methyl salt of an acid having the same composition as the first of these acids (methyl-coumaric acid) is obtained when the sodium derivative of coumarin, prepared by boiling it in alcoholic solution with sodium hydrate, is heated at 100° C. with methyl iodide. On saponifying the ether, it yields an acid isomeric with methyl-coumaric acid, and melting at 88° to 89°. The author calls it *α-methyl-orthoxyphenyl-acrylic acid*. This methyl salt, when heated at 150° C., undergoes isomeric change, and now, when saponified, yields an acid fusing at 182° to 183°, identical in all respects with that obtained from methyl-salicylic aldehyd and acetic anhydride. The fusible acid itself, also, when heated to its boiling-point, passes into the isomeric modification of higher fusing-point. The author described numerous salts of the various acids, also the acid chlorides and the amides, and concluded with some theoretical considerations as to the manner in which the acids are formed in this reaction, and their probable consitution.

The President, in thanking the author for his most interesting and important communication, said they would better be able to appreciate the immense amount of labour he had bestowed on this admirable investigation when they saw it in print. The meeting was then adjourned until Thursday, February 15, when the following papers will be read:—(1) "On the Estimation of Urea by means of Hypobromite," by Dr. Dupré; (2) "On the Influence Exerted by Ammonium Sulphide in Preventing the Action of Various Solutions of Copper," by Dr. T. Carnelly; and (3) "An Experimental Enquiry as to the Changes which occur in the Composition of Waters from Wells near the Sea," by Mr. W. H. Watson.

PHYSICAL SOCIETY.

February 3rd, 1877.

Professor G. C. Foster, F.R.S., President, in the Chair.

The following candidate was elected a Member of the Society:—Mr. J. Norman Lockyer, F.R.S.

Prof. Osborne Reynolds exhibited a number of experiments in relation to vortex motion in fluids. They have been gradually developed during the last few years, but are still in a very incomplete state, and he hopes that others will join him in the enquiry. Probably the reason why so little progress has been made in the determination of the elementary laws of fluid-motion is that mathematicians have been without experimental data on which to found their calculations. The well-known rings formed by a puff of smoke have been studied by many high authorities, but not with a view to their general bearing on this subject. Prof. Reynolds first showed smoke-rings and their interference by means of the apparatus devised by Prof. Tait, and added that although the theory of smoke-rings does not imply that vortex motion is peculiar to vapours, their existence in liquids was only pointed out by Mr. H. Deacon at a comparatively recent date. In studying the action of the screw-propeller Prof. Reynolds noticed the systematic manner in which the form of a disk moved obliquely through water is retained by the track of air which it produces. If a flat disk be supported on a light frame, and caused to move rapidly through water, the motion ceases on withdrawing the hand suddenly, but if this be done gradually the motion continues. By passing a coloured liquid down a fine tube to the back of the disk he found that a vortex ring is always formed, which passes to the rear of the disk, and the same effect is produced by dropping water from a height into water covered with a coloured liquid. In a trough about 6 feet long, and at one end of which was a horizontal tube closed with sheet india-rubber, air-rings were formed by introducing air into the tube, and then striking the india-rubber externally by means of a flat board, and it was shown that a ring is capable of propelling a vane placed in its course, to the front of which it never advances. If the air be replaced by a coloured liquid the ring travels with considerable velocity, and the motion of a solid body of the density of water is is no degree comparable. If a ring travels through a part of a liquid which has previously been coloured it causes no motion of translation, and Prof. Reynolds concludes that no resistance is offered to their motion. Nevertheless, the motion is gradually stopped, but the ring is constantly enlarging by gathering water as it travels, and its momentum remains nearly constant. After adverting to the methods adopted to ascertain the direction and velocity of motion, the initial form of the rings was shown to be a spheroid. A solid of this form, however, is very slow in its passage through water, and he considers this to be due to friction. He has succeeded in imitating the form of the ring by causing a disk surrounded by pieces of ribbon to move through water. Finally, Prof. Reynolds referred to Sir William Thomson's researches on the interference of two rings, and showed that the oscillating rings so produced can be formed in liquids by employing an oval in place of a circular aperture.

The Annual General Meeting of the Society was then held.

The President read the Report of the Council, of which the following is a brief abstract:—The Council points with satisfaction to the number and interest of the papers read before the Society, and a brief summary is given of the more important. The Society has to regret the loss of three of its members, Mr. David Forbes, F.R.S., Mr. A. S. Hobson, and Mr. Arthur Pinn. The publication of a new edition of Prof. Everett's work, and of a complete edition of Sir Charles Wheatstone's writings, is announced, and the Council hopes shortly to undertake the translation of scientific papers from foreign sources, to be published in its *Proceedings*.

The following Officers and Council were elected for the ensuing year:—

President—Prof. G. C. Foster, F.R.S.

Vice-Presidents—Profs. W. G. Adams, F.R.S., and J. H. Gladstone, F.R.S.; Mr. W. Spottiswoode, LL.D., F.R.S.; Sir W. Thomson, LL.D., F.R.S.; and Dr. W. H. Stone.

Secretaries—Prof. A. W. Reinold and W. C. Roberts, F.R.S.

Treasurer—Dr. E. Atkinson.

Demonstrator—Prof. F. Guthrie, F.R.S.

Other Members of Council—Prof. W. F. Barrett, Latimer Clark, Major Festing, W. Huggins, D.C.L.,

F.R.S., Prof. Kennedy, O. J. Lodge, Prof. H. Macleod, Prof. B. Stewart, LL.D., F.R.S., Prof. Unwin, and E. O. W. Whitehouse.

The proceedings terminated with votes of thanks to the Lords of the Committee of Council on Education for the use of the Physical Laboratory at South Kensington, and to the several Officers of the Society.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 9, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

"*On the Poisonous Properties of Yew-Leaves*," by JAMES BOTTOMLEY, D.Sc.

In the *Field* for December 23rd is a letter from Professor R. V. Tuson, relative to the poisonous action of yew-leaves on pheasants. At the end of his letter he promises to make an examination of the toxic properties of this tree, which up to the present time do not seem to have been fairly investigated. In November, 1871, a similar case came under my notice. A number of pheasants were found dead on the estate of Mr. Baring, in Hampshire. Four of the birds were sent to me for examination. Three of them contained in their craws considerable quantities of yew-leaves along with grain. The craw of the fourth bird contained neither grain nor yew; there was only a little mucus, distended with bubbles of air. The yew had no doubt passed into the alimentary canal and could not be very distinctly recognised. In the course of the investigation I found that apart from botanical characteristics the yew could yield well-marked chemical reactions. It became necessary to subject yew leaves to the same process as would be used to separate strychnine from animal tissue, the ethereal extract finally obtained having been evaporated to drive off the ether. There remained on the evaporating basin a thin varnish-like residue which was very bitter to the taste. When treated with cold nitric acid this residue assumed a dark blue colour like indigo. Upon the application of heat the colour disappeared.

"*On the Luminous Sulphides of M. Ed. Becquerel*," by WILLIAM THOMSON, F.R.S.E.

My object in bringing this communication before the Society is to show what I consider to be some most interesting substances, viz., the sulphides, principally of the alkaline earths, the luminous properties of which were studied many years ago by M. Edmond Becquerel and others. These samples which I have I received some time ago when in Paris through my friend M. Auguste Guerout, Prèparateur au Muséum d'Histoire Naturelle. They were prepared by M. André, the laboratory assistant of M. Ed. Becquerel, who has devoted much attention to the peculiarities of manipulation required to produce the greatest degree of luminosity in the sulphides after holding them for a few seconds before the sun's light, or a piece of burning magnesium wire or other source of light, and then placing them in the dark; doubtless many present will be familiar with the results arrived at by Becquerel and others, but a short résumé of some of them may not be out of place here.

When these sulphides, which must be kept in hermetically sealed tubes to prevent oxidation, are exposed to the rays at different parts of the spectrum, these rays have very different actions in rendering the sulphides luminous, and also in some cases of producing slightly different shades of colour. The visible part of the spectrum has little or no power to render these bodies phosphorescent, the violet part, however, has greatest action, and the ultra-violet rays produce the maximum effect. M. Becquerel found then, in these sulphides, an interesting method of examining the invisible parts of the spectrum, which furnished an addition to those employed, viz., the thermometer, silver compounds, &c.; these sulphides may be compared to chords which have the power of absorbing vibrations whose wave lengths are too small to affect the organs of hearing—too shrill to be heard—and of changing them into vibrations of greater wave-lengths, and emitting them, so that they may be distinctly heard.

When these sulphides are held before some source of light, the sun's rays for instance, and then placed in a dark room, they gradually, after many hours, lose their phosphorescence—if, however, they be then heated a few degrees above the temperature at which they have remained, say from 60° to 80° F., they again become faintly luminous, and if kept for some time at that temperature they gradually lose their phosphorescence again; if allowed then to cool in the dark to 60° F., and again heated to the same temperature they show no phosphorescence, but if heated to a still higher degree of temperature, say 100° F., they again become luminous, and so on; this power may be regained and lost any number of times by placing them for a few seconds before any bright source of light and then removing them to a dark room—an electric current from a Ruhmkorff's coil passed through vacuum tubes containing these sulphides also develops their different colours.

The interesting point with respect to the sulphides which I show here this evening, is that they have been prepared by a special mode of manipulation by M. André, and that the luminosity or phosphorescence capable of being produced by them is greater than that from any which hitherto have been prepared.

The following gives the compositions of the different sulphides which show the differently-coloured phosphorescences:—

Green is composed of sulphide of calcium.

Orange is composed of sulphide of calcium which has been heated with 1 or 2 per cent of binoxide of manganese.

The lime for the preparation of the above-mentioned two colours was produced by the calcination of oyster shells.

An orange-coloured phosphorescence is also produced by sulphide of barium.

Blue and *Violet* are each sulphides of calcium which have been prepared from precipitated carbonate of lime.

Yellowish Green is simply sulphide of strontium.

Yellow is sulphide of strontium which has been calcined with 4 or 5 per cent of sulphide of antimony.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

January 29th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

AT the opening of the session, the presiding officer paid a brief tribute to the memory of the late Prof. J. C. Poggendorf, the editor of the well-known *Annalen der Physik und Chemie*, who died in Berlin, January 24th.

A. PINNER read a communication from V. MEYER "*On Cuminol*," in which it was stated that if perfectly pure it did not yield cymen upon treatment with caustic potash, as given in Kraut's investigations upon the subject. The latter's researches were probably made with cuminol which had not been entirely freed from cymen.

R. MÜNKE exhibited a new rotatory aspirator, in which the necessity of changing the connecting tubes by each inversion was obviated; and some improvements in the methods for heating the air and gas supplied to a blast lamp.

C. CECH and P. SCHWEBEL described "*A Peculiar Formation of Iso-cyano-benzene*." Dichlor-acetate of aniline upon treatment with caustic soda is changed almost entirely into iso-cyano-benzene and formic acid—

$$Cl_2HC-COOH.C_6H_5NH_2=CNC_6H_5+2HCl+CH_2O_2.$$

M. Klobukowski gave the results of experiments upon the method of E. Kopp, proposed a short time since, for the "*Determination of the Halogens in Organic Compounds.*" The process consists in heating the mixture of the substance to be analysed with ferric oxide, in a narrow glass tube, the remainder of which is occupied by a spiral of fine iron wire and a layer of carbonate of sodium. It was found that by using a tube of Bohemian glass, 60 c.m. long and 5 to 6 m.m. in diameter, the combustion was ended in five to ten minutes, and that the easiest way of bringing the contents of the tube into water was to dip its lower end while still hot into a deep beaker containing a little cold water. The method is to be recommended on account of its rapidity and accuracy, as well as the ease of obtaining perfectly pure Fe_2O_3 for the purpose.

F. Tiemann and H. Herzfeld stated that by treatment of salicylic aldehyd with sodium acetate and acetic anhydride they had obtained "*ortho-coumaric acid*," $C_9H_8O_3$, in a manner analogous to the formation of para-coumaric acid from para-oxy-benzoic aldehyd. The acid is separated out in the form of the acetyl compound by solution in ether and treatment with carbonate of sodium. The melting-point of coumaric acid obtained in this way as well as by the ordinary method, is found to be 195°, instead of 207° as given by Perkin.

S. Gabriel read a paper "*On Meta-sulpho-cyanate of Phenylen*," $C_6H_4(SCN)_2$, which was obtained by the action of ICy on phenylen sulphhydrate in closed tubes. It crystallises in short needles, melts at 54°, and is changed by nitric acid and sulphuric acid into nitro-sulpho-cyano-phenylen, $C_6H_3.NO_2.(SCN)_2$—yellow needles melting at 150°.

The same author also read a paper "*On Ethers of the Tribasic (Ortho) Thio-formic Acid.*" Ortho-thio-phenylic formiate, $CH(SC_6H_5)_3$, is obtained by the action of chloroform upon sodium phenylic mercaptide, and ortho-thio-ethylic formiate, $CH(C_2H_5S)_3$, from the corresponding ethylic compound; the former crystallises in thick prisms; the latter is a liquid, boiling under partial decomposition between 200° and 250°, and possessing a most offensive odour.

Prof. Hofmann stated that a *triphenyl-guanidin* was easily obtained by the action of carbon tetrachloride upon aniline in open flasks, without having recourse to the more complicated method given at the time of its discovery.

The same author described also some experiments on the composition and preparation of a new orange colouring matter, called "*chrysoidin*," which has lately appeared in the market. Analysis proved this to be the hydrochlorate of diamido-azo-benzene, $C_{12}H_{12}N_4$, thus placing it midway between aniline yellow (mono-amido-azo-benzene) and phenylen brown (triamido-azo-benzene).

Aniline yellow, $C_{12}H_9NH_2.N_2 = C_{12}H_{11}N_3$.
Chrysoidin, $C_{12}H_8(NH_2)_2N_2 = C_{12}H_{12}N_4$.
Phenylen brown, $C_{12}H_7(NH_2)_3N_2 = C_{12}H_{13}N_5$.

Chrysoidin is easily obtained by submitting the diazo-benzene of P. Griess to the action of phenylen-diamin—

$$C_6H_4N_2 + C_6H_8N_2 = C_{12}H_{12}N_4.$$

The phenylen-diamin to be used is the one yielded by reduction of dinitro-benzene. The isomeric compound prepared from aniline yields no colouring matter. A series of analogous colouring matters may be obtained by submitting the azo-fulminates of aromatic monamines to the action of diamines.

F. Tiemann and B. Mendelsohn read a paper "*On the Components of the Creosote obtained from Beechwood Tar.*" The fraction of the acid oil of this creosote boiling at 220° consists chiefly of creosol and phlorol, and the relations of these two to other well-known compounds have been examined. Creosol has been changed first into an acetyl compound, and then by oxidation into vanillic acid, and receives, therefore, the structural formula $C_6H_3(CH_3)(OCH_3)(OH)$, the sidelinks in the order 1, 3, 4. Phlorol was changed first into methyl-phlorol, and this was oxydised to an oxyphthalic acid, identical with that obtained from salicylic acid. Phlorol is therefore to be regarded as an oxy-xylen, $C_6H_3(CH_3)_2(OH)$.

The following papers from non-resident members were read:—

H. Wald, "*On Para-dinitro-diphenyl.*" On treatment with sodium amalgam 2 molecules of this compound unite together, under separation of 3 atoms of oxygen, forming an azo-oxy-nitro-diphenyl.

A. Baeyer, "*On Phenanthren-quinon.*" By boiling with soda this body takes up a molecule of water, and forms an aldehyd acid of the formula $C_{14}H_{10}O_3$.

T. Heymer, "*Action of Sodium on Succinic Ether, and a Peculiar Formation of Hydroquinon.*" By the action of sodium a complicated ether, analogous to aceto-acetic ether, is produced. If treated with soda and sulphuric acid while protected from the action of the air, it yields hydroquinon. With acetic acid, and an incomplete exclusion of air, an acid of the following composition is obtained:—$C_6H_2O_2(COOH)_2$.

A. Baeyer, "*On Aldehyds of the Phthalic Acids.*" The author obtains them from the acid chlorides by treatment with hydriodic acid and phosphorus.

J. Berger, "*On Oxy-terephthalic Acid.*" This compound, $C_6H_3(OH)(COOH)_2$, was obtained from the diamido compound, and gives with HCl oxy-salicylic acid.

F. C. Muller, "*On the Temperature of Aqueous Vapour under Normal Conditions.*" Experiments show that there is no condensation of water upon the bulb of a thermometer surrounded by aqueous vapour and marking 100°, if it be previously warmed to that temperature, and condensation upon the upper part of the tube be prevented.

C. Göttig, "*On the Synthesis of Aldehyds.*" The author applies successfully the method of distillation of calcium formiate with the calcium salt of the corresponding acid to the synthesis of ethyl-salicyl-aldehyd,—

$$C_6H_4(OC_2H_5)(COH),$$

but is unable to obtain salicyl-aldehyd itself.

H. Schwanert, "*Dinitro-toluen-sulphonic Acids.*" The author has obtained two isomeric acids of this composition, $C_6H_2(CH_3)(NO_2)_2(SO_2H)$, one of which, dinitro-para-toluen-sulphonic acid, derived from ortho-nitro-para-toluen-sulphonic acid by the action of HNO_3, is described fully. A number of salts, the amide, chloride, and various compounds with acids, are also described.

A. Bernthsen, "*Action of Nascent Hydrogen upon Benzo-thiamide.*" Sodium amalgam in an alcoholic solution reduces benzo-thiamide to benzo-thialdehyd, $C_6H_5.CSH$.

B. Zöller, "*On the Conservatory Properties of Potassic Xanthate.*" A small addition of this salt is found sufficient to prevent decay and fermentation in organic bodies for an indefinite period. The juice of the grape and other fruits can be preserved in this way perfectly fresh, even when exposed to the air. On account of its cheapness, easy application, absence of dangerous properties, and the small amount required, potassic xanthate can well replace many conservatory substances at present in use.

A. Raab, "*On some Derivatives of Cuminic Aldehyd.*" Among these are dicuminyl-carbamide, $CO(NHC_{10}H_{13})_2$, dicuminyl-sulpho-carbamide, and hydro-cuminoin, $C_{20}H_{26}O_2$. The latter was obtained by reduction of the aldehyd with nascent hydrogen, and gives acetyl-, chloro, and other derivatives.

K. Stuckenberg, "*On Para-nitro-ortho-sulphi-phenol.*" This body has been obtained in the form of the calcium-salt, $C_6H_3NO_2SO_2OCaO$, by the action of nitric acid upon the potassium salt of ortho-sulphi-phenol.

B. Radziszewski, "*On the Phosphorescence of Lophine, Amarine, and Hydro-benzamide.*" The author has found that if lophine is dissolved in an alcoholic solution of potassic hydrate an exceedingly brilliant phosphorescence takes place. An extensive series of experiments showed that the phenomenon did not occur in other solutions of lophine, or by the action of heat or friction; also that it was partially due to a slow process of oxidation, although

not entirely. Ammonia and potassic benzoate were the decomposition-results of the reaction. Amarine and hydro-benzamide displayed the phenomenon under the same conditions, but much less brilliantly. The author attributes it to causes analogous to those inducing the phosphorescence of phosphorus itself.

R. STRUVE, "*Derivatives of Phenanthren.*" The author has obtained from phenanthren-quinon dinitro-phenanthren-quinon, a heavy yellow powder, and changed this by oxidation into dinitro-diphenic acid,—

$$C_{12}H_6(NO_2)_2(COOH)_2.$$

Reducing agents yield a diamido-diphenic acid, a white amorphous powder, the hydrochlorate of which gives by distillation with soda-lime diamido-diphenyl.

CORRESPONDENCE.

DOCTOR'S DIPLOMAS.

To the Editor of the Chemical News.

SIR,—Dr. P. Townsend Austen calls attention to an advertisement which is appearing in the *Kladderdatsch*, offering degrees for sale, Ad., Medicus, Royal Square, Jersey, England.

The degrees emanating from this source are not English degrees, but degrees from the "University of Philadelphia," and have been very frequently exposed in the papers here.

As these bogus degrees are by this time too well known in this country to be profitable, the enterprising advertiser is probably trying them on in Germany.—I am, &c.,

A. A. R.

London, February 5, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 4, January 22, 1877.

Memoir on Electro-Capillary Actions, Treating of (1) the Depolarisation of the Electrodes, as well as of the Electric Effects Produced at the Point of Contact of the Membrane and of Various Liquids; (2) the Relations between the Electromotive Forces, the Quantities of Heat Liberated during their Production, and the Diffusive Powers.—M. Becquerel.—The nature of this paper appears sufficiently from the title. The author considers that he has arrived at a more exact determination of the electro-motive forces, and a more complete study of the intervention of electro-capillary actions in the phenomena of life.

Researches on the Substituted Eugenols.—M. A. Cahours.—The author has obtained and studied propyl-eugenol, $C_{26}H_{18}O_4$, a mobile liquid of a pale amber colour, with an odour recalling that of the carnation, insoluble in water, readily soluble in ether, boiling between 263° and 265°, and of the specific gravity 1·0024. Iso-propyl-eugenol boils between 252° and 254°, and its specific gravity is 0·199 (?). Butyl-eugenol, $C_{24}H_{16}O_8$, boils between 272° and 274°, and of specific gravity 0·985. It may be regarded as methyl-butyl-proto-catechuic acid. Amyl-eugenol, $C_{30}H_{22}O_4$ (amyl-methyl-proto-catechuic acid), boils between 283° and 285°, and its specific gravity is 0·976. Hexyl-eugenol boils between 296° and 300°. Allyl-eugenol, $C_{26}H_{16}O_4$, boils between 267° and 270°, and has the specific gravity 1·018. The author has also obtained benzyl-eugenol and ethylen-eugenol.

Contemporaneous Formation of Zeolites (Chabasie and Christianite) under the Influence of Hot Springs in the District of Oran, Algeria.—M. Daubrée.—In certain fragments of Roman masonry, consisting of lime cementing together fragments of brick, were found zeolitic crystals of the kinds just mentioned.

Capacity of Saturation of Manganous Acid.—M. A. Gorgen.—The author concludes that the binoxide of manganese at the moment of its formation is a bibasic acid. The other manganites of the formula $(5MnO_2)RO$ are not saturated manganites, but manganites in equilibrium with reference to the medium in which they have taken their origin. The hydrated binoxide of manganese prepared artificially may be regarded as a modification of manganous acid in the nascent state.

Action of Heat on Quercite.—M. L. Prunier.—In the first stage which extends to +280° in a vacuum the substance loses water, and there are formed neutral compounds, among which is found a volatile body, quercitic ether. All the compounds formed are neutral, soluble in water, insoluble in alcohol and ether, and regenerate quercite if boiled in water. Above 280° to 300° the molecule is abruptly broken up; carbonic acid escapes, and there are formed crystalline acid bodies, more volatile and more fusible than quercitic ether.

Fermentation of Urine.—Dr. C. Bastian.—A continuation of the controversy with M. Pasteur.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 35, November, 1876.

Note on the Nickel Extracted from the Ores of New Caledonia.—MM. Paul Christofle and H. Bouilhet.—The substance of this paper has been already inserted in the CHEMICAL NEWS.

No. 36, December, 1876.

Report made by M. Lamy on behalf of the Committee of Chemical Arts on the Distilling and Rectifying Apparatus of MM. Savalle, Fils, and Co.—It is impossible to give an intelligible account of the apparatus employed by the inventors without the accompanying illustrations.

Report made by MM. Cloëz and De Luynes on behalf of the Committee of Chemical and Economical Arts on the New Saccharimeter of M. Laurent.—The apparatus is arranged like the polariscope of Mitscherlich, from which it differs merely in the construction of the polariser. It consists of a combination equivalent to two Nicol prisms in juxtaposition, of which the principal sections form an angle of 5°. A full description of the apparatus would require the aid of illustrations.

Les Mondes, Revue Hebdomadaire des Sciences, December 14, 1876.

According to M. Legrand there are grievous complaints concerning the defective ventilation of the hall in which the Academy of Sciences holds its meetings. The evil is aggravated by the fact that a certain illustrious physiologist has a great dread of an open window.

Composition of the Baths for Tempering Glass.—In water the glass almost invariably breaks. Fatty matters perfectly purified, and virgin oils free from all admixture, give good results. The temperature employed varies from 150° to 300°. Glycerin, whether pure or mixed with fats, cannot be advantageously employed.

December 21, 1876.

This issue contains nothing of interest save a paper by M. Recamier on the "Action of Light as a Motive Power," which we shall endeavour to reproduce in full.

MEETINGS FOR THE WEEK.

MONDAY, 12th.—London Institution, 5.
— Medical, 8.
— Royal Geographical, 8.30.
TUESDAY, 13th.—Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
— Civil Engineers, 8.
— Anthropological Institute, 8
— Photographic, 8. (Anniversary).
WEDNESDAY, 14th.—Society of Arts, 8.
THURSDAY, 15th.—Royal, 8.30.
— London Institution, 7.
— Royal Society Club, 6.30.
— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
— Chemical, 8. "On the Estimation of Urea by means of Hypobromite," by Dr. Dupré, F.R.S. "On the Influence of Ammonium Sulphide in Preventing the Action of various Solutions on Copper," by T. Carnelly. "An Experimental Enquiry as to the Changes which Occur in the Composition of Waters from Wells near the Sea," by W. H. Watson.
FRIDAY, 16th.—Royal Institution, 9. "Solid Water," by Prof. F. Guthrie.
— Geological, 1. (Anniversary).
SATURDAY, 17th.—Royal Institution, 3. "Florence and the Medici," by J. A. Symonds.
— Physical, 3.

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THE CHEMICAL NEWS.

VOL. XXXV. No. 899.

QUANTITATIVE ANALYSIS OF CERTAIN METALS IN IRON AND STEEL.

By SERGIUS KERN, St. Petersburg.

In several specimens of analysed hard steels from 0·3 to 0·5 per cent of tungsten was detected. The specimens in hand were received from Sweden as steel for instruments, especially for files. In analysing this steel for tungsten it was found very troublesome to evaporate to dryness the ammoniacal solution of tungstic acid, as the boiling liquor is very often thrown out from the beaker. The following alteration in this process was found to be very practical:—

5 grms. of the specimen are dissolved in aqua regia, and the solution is evaporated to dryness, and then dissolved in a mixture of 25 c.c. of water and 15 c.c. of hydrochloric acid. The resulting precipitate contains silica and tungstic trioxide (WO_3); it is next filtered from the solution, washed first by water acidulated by 5 per cent of hydrochloric acid, and finally by pure alcohol. The tungstic trioxide is dissolved on the filter in strong ammonia; the filtrate is boiled for twenty minutes with 5 grms. of caustic lime or caustic potash; hydrochloric acid is next added, the solution is heated for some time, and the remaining precipitate of pure tungstic trioxide is filtered from the liquor, dried on the filter, carefully ignited, and weighed. WO_3 contains 79·31 per cent of tungsten.

Having made several new experiments with *chromeisen* prepared by the process described in my article in the CHEMICAL NEWS (vol. xxxii., p. 136), I may strongly recommend the use of it in steel manufacture instead of spiegeleisen and ferro-manganese. The resulting steel is very soft and is far superior to the steels now in use for the preparation of boiler plates, tyres, guns, wire, &c. In preparing such cast-steel in every crucible, containing ordinarily 70 to 80 lbs. of raw material, 0·75 to 1·60 per cent of chromeisen containing 50 to 60 per cent of metallic chromium is added. In analysing the resulting chrome-iron alloys the following process may be used. The work is quickly executed:—

From the solution containing iron and chromium, these metals are precipitated by ammonium sulphide $[(NH_4)_2S]$; the resulting precipitate is filtered from the liquor, dried, and ignited for 30 to 40 minutes in a platinum crucible with 4 parts of a mixture of equal quantities of KNO_3 and K_2CO_3. The ignited and fused mass is placed in a glass, and hot water with 5 per cent of alcohol is next added. The liquor is boiled and filtered from the precipitate; the solution contains only the chromium salt, which is precipitated by adding an excess of ammonia in the form of chromium hydrate ($Cr_2O_6H_6$), which is strongly ignited; the resulting chromium oxide (Cr_2O_3) is weighed and the percentage is calculated knowing that this compound contains 32·2 per cent of chromium. In analysing iron and steel the manganese is usually separated from the iron by sodium acetate, which throws down the iron and leaves the manganese in solution, which is precipitated either by ammonium sulphide in the form of manganese sulphide, or by bromine in the form of hydrated manganese dioxide ($3MnO_2+H_2O$), which is next ignited, and the resulting manganese compound, manganomanganic oxide (Mn_3O_4), is weighed. The first process of precipitation of manganese by $(NH_4)_2S$ is, however, a dirty operation, giving at the same time not such correct results as the bromine process. But as bromine is expensive the use of it in laboratories is limited. The strong irritating smell is also a drawback in using this element for analytical researches. I propose to replace the bromine in this case by sodium hypochlorite, which, in solutions of manganous salts in the presence of an alkali, throws down the manganese in the form of hydrated manganese dioxide by the following equation:—

$$MnCl_2+NaOCl+2NaHO=(MnO_2+H_2O)+3NaCl.$$

The sodium hypochlorite may be easily prepared and is cheap.

Obouchoff Steel Works, St. Petersburg.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 50.

Manufacture of Sulphuric Acid. By ROBERT HASENCLEVER, Manager of the Stolberg Works.

If the slope of the ground permits no other arrangement the waggons may have a low shape, and the tram-way may be on the same level as the floor of the furnace. At the Rhenania and in other places where the pyrites can be brought up on to the kilns without difficulty, the charge of lump-ore is introduced through an aperture in the vault, and the process does not take more than 20 seconds. If it is too difficult to convey the ore upon the top of the kilns it is thrown in with shovels through the working door. In this manner 400 kilos. can be introduced in five minutes. As charging always disturbs the progress of the furnace it is advisable to restrict it to a minimum of time.

Poor lump-ores are roasted in Freiburg and Oker in small shaft furnaces with a lateral exit for the gases, and a low vault in which a high layer of ore is constantly maintained.†

As for the roasting of smalls and rough fragments it is sometimes carried on along with the lump-ores. This method is not advantageous, and renders the burning of the whole of the pyrites imperfect.

It is better to work up the smalls into balls (Klutten, Stöckeln, *Boulets*).

For this purpose they are mixed with more or less clay and water, and moulded into balls or cut in pieces. The dried balls are then burnt either alone, or mixed with lump-ores in the kilns described above. English establishments which burn Spanish cupriferous pyrites mix the finely ground ore with water without clay, and mould the paste into balls, which hold together owing to the presence of vitriol.

For roasting smalls and coarse powder several kilns have been latterly proposed.

In 1862 the so-called shooting-kilns were introduced at Freiberg, their original and ingenious construction being due to Moritz Gerstenhöfer. They have been described in most technological journals, and in Schwarzenberg's "Treatise on the Manufacture of Sulphuric Acid" (p. 415), they are represented in figures drawn to scale. F. Bode, assistant in Gerstenhöfer's technical office, describes them in detail in his pamphlet "Contributions to the Theory and Practice of the Manufacture of Sulphuric Acid."‡ He deals at length with all the objections to Gerstenhöfer's furnaces, and endeavours to refute them.

The ores to be burnt in Gerstenhöfer's kilns must first be ground to a fine powder. They are desulphurised whilst falling down a shaft of about 5 metres high, 1·25 metres wide, and 0·8 metre deep. This shaft is fitted up with three-sided prisms of fire-clay, arranged with one

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehntes."

† Compare Graham-Otto's *Lehrbuch*, Band 2, abth. 1, 549.

‡ "Beiträge zur Theorie und Praxis der Schwefelsäure Fabrication."

angle downwards and one side upwards so that intervals remain between them, and the particles of ore fall from one prism to the next. The raw ore is introduced continuously by means of a hopper, and the burnt residue is withdrawn from time to time below. The furnace is heated with wood or coal previously to entering the ores, and as soon as they are introduced the fire is withdrawn, as the combustion of the sulphur keeps up the necessary temperature. Rich ores are passed through the kilns in small quantities and poor ores more rapidly.

Instead of putting in furnace bars below and removing them again when the kiln is warm, the author introduced a permanent lateral fire in the Gerstenhöfer kilns built at Stolberg, which was ready for use on a change of ores or any interruption of the process. In Stolberg the burnt ore, also, was drawn at once out of the furnace into a truck, introduced below the bottom sliding plate. Both these arrangements were considered by Bode as improvements.

Gerstenhöfer's kilns afford the great advantage that poor ores may be burnt without the aid of fuel, so as to produce rich gases of a constant composition and fit for the chambers. If perfect burning is not required they are unequalled. At Vedrin, in Belgium, where the good pyrites are sold and only the inferior qualities are used for the preparation of acid, satisfactory results are obtained with them, as also in Freiberg, where a mere preliminary roasting of mixed ores is required.

For roasting rich smalls this furnace has not come into general use, and is employed neither in France nor in England (except for copper-ore at Swansea). It has been abandoned at the chemical works at Chauny (Dep. Aisne), of Widnes (Lancashire), of Nienburg on the Weser, and of Stolberg, on account of imperfect burning and excessive production of flue-dust.

A furnace for smalls invented by Perret was shown as a model at the Paris Exhibition of 1867, and has been fully described by Schwarzenberg.* This furnace consists of several stages of horizontal plates arranged above a kiln for lump pyrites. These plates are fixed at intervals of 30 centimetres, and are covered with smalls to the depth of 5 to 8 centimetres. The hot gases from the kilns below sweep over them whilst ascending, and exhaust them of sulphur. Perret's furnace has been in action for years in the Wohlgelegen Chemical Works, near Mannheim, but otherwise it has remained confined to France. As originally designed it rose to the height of 6 metres above the furnace, and required much labour, as the ores had to be pushed up from stage to stage, whereby also some sulphurous acid escaped. The most recent Perret furnaces are essentially modified and act very satisfactorily. They are a little above 2 metres in height, and have only four ranks of plates, which can all be charged from the level of the furnace. The ore burns clean on every plate, and does not require to be pushed up from below. In this manner equal weights of lump and smalls are burnt.

Maletras, of Rouen, set up a plate furnace on Perret's principle, in which rich smalls are thoroughly roasted alone without lumps, and without the aid of coal. Similar kilns are in use at Dieuze and near Berlin. The roasting of poor smalls at Dieuze has proved unsatisfactory, although the ore was dried before charging the furnace. Smalls of 46 to 48 per cent of sulphur were burnt down to 3 or 4 per cent.

In 1861 Peter Spence patented a furnace in England† similar to those which had been in use for twenty years in Belgium, and at Stolberg, near Aachen. The furnace was worked with fuel, which heated a muffle, constructed of arches, for the reception of the ores. Much air entered through the working doors, so that the gases contained but little sulphurous acid. A kiln of this kind is still in use at the Works at Imeary, near Newcastle-on-Tyne. In Spence's establishment it has fallen into disuse, and has altogether found but a very limited application.

* Bolley, "Handbuch der Chem. Technologie," ii., 421.
† A.D., 1861. Specification No. 3002.

Allhusen, of Gateshead, burns smalls on iron plates above the lump pyrites. Nothing has transpired concerning the working of the process.

The "Rhenania" Chemical Works of Aachen exhibited at Vienna, in 1873, models of the kilns which were first constructed at Stolberg, on the principle of Wilhelm Helbig and of the author.* These kilns serve for burning finely powdered sulphur ores, and especially for iron-pyrites and zinc-blende. The peculiarity in the construction is that the ores are roasted upon strongly inclined planes, down which the pulverulent mass slides when a portion of ore is taken away from below.

The plate furnace described in 1870 is in extensive use for burning the smalls resulting from breaking up the ores, and is at present being set up in several manufactories. It is charged with a mixture of coarser and finer fragments, sand-ore, and meal-ore. The lumps are burnt in the ordinary manner close by the plate tower, and the hot gases escaping, sweep over the plates and burn the smalls. The ore passes over the plates in the form of a continuous stream, the thickness of which is determined by the interval between two plates. Green ore is added and burnt ore withdrawn without interrupting the process. The upper aperture is kept covered with a heap of ore, so that as it slides down no sulphurous acid can escape at the hopper. At the lower part of the furnace the burnt stratum of pyrites is removed by means of a roller, which revolves automatically every five minutes, and is driven by a small water wheel. Paul Seybel, of Liesing, near Vienna, works the kiln intermittently withdrawing about 200 kilos. of burnt ore every six hours by turning the roller. As smalls in very fine powder do not slide down well, Seybel's method is preferable for such ores. At Liesing, ores from Bösing, in Hungary, are burnt in plate kilns down to about 4 per cent, and Styrian ores down to about 7 or 8 per cent. The burnt lumps of the latter kind retain 5 to 6 per cent of sulphur, whilst lump ores from Bösing burn down to 2 per cent.

Burnt smalls from the "Sicilia" mine, near Siegen, retain 4 to 5 per cent of sulphur according to the size of the furnace and the quantity of ore passing through it. The burnt lumps which have been roasted along with smalls retain 5 per cent of sulphur, whilst clean lumps burn down to 2 per cent. There is therefore a decided improvement in roasting these kinds separately.

(To be continued.)

ON THE FORMATION OF MOSS GOLD AND SILVER.†

By ARCHIBALD LIVERSIDGE,
Professor of Geology and Mineralogy in the University of Sydney.

The origin and mode of occurrence of certain of the metals which are found in the free or native state, both in mineral veins and disseminated through various rocks, has for some time been a question of much interest to me: my attention, however, has hitherto been directed more particularly to the circumstances connected with the occurrence of native gold and of the minerals with which it is usually found associated; and it was while performing an experiment to ascertain, if possible, whether the gold which was known to be present in a certain specimen of mispickel existed in the crystallised state, or was merely disseminated through the mineral in amorphous particles, that I first obtained the peculiar form of gold which I now have the pleasure to exhibit to the Society.

I have called this remarkable, and to myself hitherto unknown, artificial form of the metal "moss gold," because in many respects it resembles the well-known "moss copper,"—hence it is convenient to use the above

* *Zeitschr d. Ver. Deutsch. Ingen.*, 1870, p. 705, and 1872, p. 505.
† Read before the Royal Society of N. S. W. September 6, 1876.

term for it, although it should be stated that none of the specimens of gold presented anything like so *velvety* an appearance as that commonly exhibited by moss copper.

One of the two specimens before me was a rich piece of mispickel from the Uncle Tom Mine, near Orange, I believe, and the other a somewhat richer specimen from Paxton's, or the Rampant Lion Mine, Hawkins' Hill, obtained from a depth of 200 feet. Both contained some visible gold; the first only a few small specks, but the second was fairly rich in free gold, although the amount was not to be compared to that which it now shows. Mispickel, I may remark, is a compound of arsenic, sulphur, and iron, combined in the following proportions:—

Iron	=	34·4
Sulphur	=	19·6 (or $FeAs_2FeS_2$)
Arsenic	=	46·0
		100·0

The first specimen was roasted in a muffle, in order to expel the sulphur and arsenic, and my intention then was to dissolve out the oxide of iron and to examine the residual gold for crystals or any trace of crystalline structure which might be present, as I hoped by the above means to set the gold so completely free from the matrix that I could at once ascertain whether it existed in the mispickel in a crystallised form or only in irregular or amorphous lumps and particles.

On taking the specimen out of the muffle after the whole of the arsenic and sulphur had been driven off, I found that the surface was studded with small, irregular, more or less rounded excrescences of gold, having much the appearance and colour of small drops of sulphur. On closer examination, and especially with the aid of the microscope, the surfaces of these mushroom-like growths were seen to be covered with minute capillary wires and branching forms, which in some cases appeared to be made up of minute irregularly-formed crystals. This is more noticeable in the second specimen. Some of the cavities in the gold are seen to be lined with the most beautiful little spiculæ of gold, and some of the rounded bosses are composed solely of such spiculæ, interlaced into a ball-like form. Many of these capillary wires are curled into most symmetrical and beautiful spirals; one about $\frac{1}{4}$ to $\frac{1}{8}$ inch in length, and of about $\frac{1}{150}$ inch in diameter, is coiled with the utmost regularity, the pitch of the screw being maintained uniform throughout its entire length.

In some cases the mushroom-like growths are seen to be supported on but a very slender stem, while others have apparently become recumbent from their weight, and have grown along the surface.

It is by no means an uncommon thing to find natural gold in the form of capillary threads, which are often interlaced and twisted into beautiful and fantastic shapes; also as thin flakes and scales, having a more or less fibrous surface; and at times in scales so exceedingly thin that they are not thicker than ordinary gold-leaf. Some of the gold from Oura, near Wagga Wagga, occurs in this manner. The best-known Australian locality for filiform gold is, perhaps, the Upper Cave River, Queensland.

I should mention, however, that I have never seen or heard of any native gold presenting exactly the same kind of appearance as the before-described artificially-formed specimens, but certainly the latter is at times somewhat similar.

Origin of the Moss Gold.

The general appearance of these peculiar cauliflower-like excrescences of gold would, at first sight, tend to give one the impression that they had been formed in somewhat the same way as the blebs and excrescences often observed on coke, which are so familiar to us in a fire made of so-called bituminous coal,—*i.e*, caking coal,—in which constantly we see portions of the coal fuse and swell up into fantastic blebs and bladders until the imprisoned gas breaks through the thin skin and inflames with a brilliant light. After the more combustible portions have been volatilised and consumed, a hard, clinkery, and more or less cauliflower-like excrescence is left.

But I do not think that we can account for the form of these cauliflower masses of gold in a similar way, for the mispickel shows no traces of having undergone fusion, neither does the gold; the crystals of mispickel, which by the operation of roasting have become converted into oxide of iron, still retain their original form, even down to the jagged points along the sharp splintery edges of fractured surfaces. Hence it cannot be urged that the gold had merely been left in the form assumed by the fused mispickel in the same way that a cauliflower mass or capillary thread of coke is left by the escaping gas from a piece of fused coal.

Neither can the gold have been merely squeezed out through pores in the matrix by mechanical pressure, in the same way that clay is forced through moulds in the manufacture of earthenware drainage-pipes, for the enclosing matrix of mispickel during the operation of roasting becomes comparatively soft and tender. Hence it could not well offer sufficient resistance to the expansion of the gold to act as a wire draw plate, even if we suppose that the gold existed in the form of small pockets of metal, and that there are the necessary minute apertures and perforations in the mispickel through which the expanding gold could make its escape.

And again, the forms exhibited by the gold show that it has not been in a fused condition, neither does it appear even to have been of a pasty consistency.

To ascertain whether this remarkable form of gold was furnished by artificial mixtures of the metal and mispickel, or was solely confined to those occurring in nature, a series of experiments was commenced, and the results obtained satisfactorily showed that the same phenomena were presented by certain of the artificial mixtures employed.

Experiment.—80 grms. of powdered mispickel were fused under a film of borax with 1 grm. of precipitated gold. The whole of the gold was apparently taken up by the mispickel, for no metallic particles or shot could be detected in the fused mass of regulus. The button of regulus was then roasted at a low red-heat in the muffle; it fused, but after the whole of the arsenic and sulphur had been driven off, the oxide of iron was found to be more or less covered with a brown, non-metallic-looking, cauliflower-shaped mass of gold. On scraping it with the point of a knife the unmistakable yellow metallic streak of gold was at once exhibited.

Moss Silver.

Next a series of experiments was made in order to ascertain whether any light would be thrown upon the subject by the behaviour of silver compounds under somewhat similar conditions.

The first experiment was the reduction of silver chloride, in a bulb tube, by the passage of a current of pure dry hydrogen, mentioned by Dr. Percy, F.R.S., in his great work on "Metallurgy," and by other writers.

The silver chloride was allowed to fuse, but the temperature was kept very much below the fusing-point of silver, so much so that the glass was not even softened.

The surface of the reduced metal was somewhat mammilated and cavernous, and it was found in certain places to be covered with minute capillary threads and spiculæ of silver; the cavities also were more or less filled with them.

Some silver sulphide was prepared in the humid way from silver nitrate. This was well washed, dried, and transferred to a French crucible, and then fused under a layer of borax in an ordinary melting-furnace.

The mass of sulphide, weighing about 2 ozs., was then cut in two by means of a large knife and hammer, and one of the two parts roasted in a muffle furnace. The

piece of silver sulphide was placed on a small scorifier, just inside the mouth of the muffle, where for some time the temperature did not exceed the melting-point of tin (fus. about 442° F.). Within a very few minutes (between 10 and 15 minutes) after the lump of silver sulphide had been placed in the muffle, beautiful little growths of metallic silver were seen to be dotted over its surface, and particularly near the upper edges; the lower portion of the mass, to a height of about ¼ inch, only presenting one or two points of silver at the right-hand end. This experiment was repeated several times with fresh pieces of the silver sulphide.

The projecting filaments had a most brilliant silver-white colour and lustre.

Their surfaces are strongly striated parallel to the length of the filament, and the larger ones are in most cases more or less curved or spirally convoluted. Towards the base the majority become much thicker, and in one direction they are usually much broader than in the other; hence they in this respect somewhat resemble blades of grass.

In certain instances the crystals could almost be seen to lengthen; a perceptible increase in length in more than one instance was observed within the space of between one and two minutes.

The crystals seem to increase in length and thickness far more rapidly during the first hour than afterwards, and their growth does not appear to be materially hastened by urging the temperature; that between the melting-points of tin and zinc (770° F.) appeared to be the most favourable. At a higher temperature the whole surface of the silver sulphide becomes covered equally with a coat of metallic silver.

The extrusion of the silver crystals cannot well be caused by pressure from without inward, for neither the silver nor the silver sulphide undergoes fusion or even softening; neither can the production of the filaments be due to the simple and ordinary process of reduction by the removal of the sulphur as sulphurous acid gas, otherwise the whole surface of the mass of heated and more or less roasted sulphide should be covered with a coat of reduced metallic silver, just as when the sulphide is reduced in a current of hydrogen gas. But such is not the case; the extruded wires and filaments appear to be rooted in the sulphide, as if they pushed their way out from within, and they usually project out at nearly right angles to the surface of the apparently unchanged dark lead-coloured silver sulphide, just as Dr. Percy describes the formation of silver filaments, from the same compound under the reducing agency of a current of hydrogen gas.

It may be that their formation may have been determined by the presence of nuclei of some sort, just as in the case of various saline solutions.

On even the most searching examination I cannot detect any difference between the filamentous silver thus artificially formed and specimens of similar native silver.

Since making my experiments, I find that De la Beche says, in his "Geological Observer," p. 768:—

"Artificial sulphuret of silver was found to be readily decomposed by steam, and more easily so at a moderate heat. At a temperature under the melting-point of zinc this was soon effected, and the silver effloresced in such forms as to induce M. Gustav Bischoff to regard the moss-like and filamentous occurrence of native silver in veins as very probably the result of the decomposition of sulphurets."

Moss Copper.

It is a well-known fact that metallic copper occurs diffused through certain kinds of copper regulus, in the form of minute angular particles, which do not show the least trace of having undergone fusion: all the edges of these particles are sharp and not in the least rounded, and where cavities occur the metallic copper may be seen protruding into them in the form of minute points and hair-like threads or filaments."

Dr. Percy, in speaking of *moss copper*, says*;—"In copper works this term is commonly used to designate those accumulations of filamentous or moss-like copper which are formed in cavities in pigs of certain kinds of regulus. Mr. Edward informs me that, in making copper from Cornish ores, moss copper seldom appears, but more of it is produced when these ores are melted in admixture with a little Irish ore (copper pyrites mixed with *much iron pyrites*): it occurs most abundantly when foreign ores are much used. It is chiefly observed, and in the finest state, in *pimple metal*, when all the cavities are filled with it, and it is found protruding from the bottom of the pigs into the sand underneath; sometimes a little of it, strong and wiry to the touch, appears on the upper surface of the pigs. According to Mr. Edward, it may be seen in the little prills or shots of *metal* in the ore slag; and the surface of the pigs of metal from the *calcined metal* furnaces are covered with a coating of it, generally of a dark colour, and as thick as the nap or pile on velvet.

"In specimens in my collection the filaments of copper vary in size from the finest thread to fibres 3-16ths of an inch in diameter, and from one of three specimens obtained from a *fine-metal* furnace-bottom I have taken separate filaments perfectly continuous, and exceeding 5 inches in length.

"Under the microscope the filaments present numerous minute parallel and longitudinal lines or grooves, as though they consisted of bundles of extremely delicate fibres. . . .

"The mode in which these fibres are produced is an interesting subject of inquiry. Each fibre seems to have been pushed, as it were, through a draw-plate, and at a temperature when the metal was soft, but certainly not exceeding that of well-melted copper, for otherwise the fibres immediately after their protrusion would have been re-melted into globules." Then he goes on to mention that "filaments of silver, which, examined under the microscope, appear to possess *identically the same structure* as those of moss copper, may be formed by heating finely-divided sulphide of silver in a current of hydrogen at a temperature sufficient to agglutinate the sulphide, but below the actual melting-point of silver. This beautiful experiment may be made in a glass tube, through which a current of the gas is passed. Long delicate fibres of silver may be seen protruding from minute rounded masses of the sulphide; and as they are produced while these masses are in a soft state, and lying free in the tube, the idea that they result from the application of external mechanical pressure, in a similar manner to maccaroni, can hardly be entertained.

"There seems to be a force in operation at the base of each filament, which causes the particles of silver at the moment of liberation successively to arrange themselves in one continuous fibre or series of fibres; or, in other words, each filament grows, as it were, from a root imbedded in sulphide of silver."

Experiment.—I placed some lumps of native copper disulphide (*Redruthite*) in a hard-glass bulb tube, heated and passed current of hydrogen gas. After the experiment the whole surface of the mineral was found to be thickly covered with a nap of acicular filaments of copper. No traces of fusion were exhibited.

Dr. Percy also shows by a series of experiments that metallic copper is separated in a similar way by simply fusing some copper disulphide (Cu_2S) in a crucible. And he further states that there is at present no certain knowledge of the cause which brings this about.

The foregoing results obtained by different eminent scientific observers, together with those yielded by my own experiments, afford, I think, some very interesting information, much important matter for reflection, and a large field for future experiment.

The conditions under which the formation of crystals have been observed may be briefly stated to be comprised by the following divisions; *i.e.*, crystallisation takes place under the following conditions.—

* Percy's "Metallurgy," vol. i., p. 359.

Methods by which Crystallisation may be produced.

1. By condensation from a state of vapour.
2. From solution.
3. From a state of fusion.
4. By electrolysis.
5. By "spontaneous" change.
6. By thermo-reduction.

1. *Condensation* of a substance from a state of vapour, —*e.g.*, iodine, arsenic, water-vapour yielding snow and hoar-frost.

2. *Crystallisation from Solution.*—As when crystals of a salt are obtained by the evaporation of its solvent, and as when a solution of sulphur in carbon disulphide is allowed to evaporate spontaneously, beautiful crystals of sulphur are left.

3. *On Solidification from a State of Fusion.*—This is commonly seen when metals such as bismuth, antimony, and others are allowed to solidify slowly. Beautifully crystallised examples of such metals and of sulphur may be readily obtained in the following way:—Melt a considerable quantity of the substance in a crucible or ladle, and when a thin coat has formed over the surface by cooling, pierce the crust, and pour out the still fluid contents as quickly as possible. A large part of the metal or sulphur, as the case may be, will be left lining the inside of the crucible in the form of most beautiful groups of crystals with sharply-defined edges and angles, and not as the rounded, imperfect, semi-fused-looking bodies that we might naturally expect when we consider the density and viscosity of the fluid in which they were formed and by which they were bathed.

4. *Crystallisation by Electrolysis.*—When solutions of the salts of the heavier metals are submitted to the action of electric currents they undergo decomposition, and the metal which is deposited at the negative pole is usually more or less crystallised. A current of low intensity, *cæteris paribus*, seems to favour the formation of well-developed crystals. The reduction of a metallic solution by a more electro-positive element may probably be classed under this head, as stannic chloride by zinc, or silver nitrate by lead, and so on.

5. *Spontaneous Crystallisation*, as it is usually termed, —*e.g.*, the gradual passage of amorphous plastic sulphur into the crystalline state, also the similar change undergone by barley-sugar. Many well-known chemical precipitates apparently undergo spontaneously a similar change. Again, the gradual conversion of tough fibrous wrought-iron into hard brittle iron with short grain, by repeated concussion and vibration, seems to be a variety of crystallisation; certainly a great molecular change has taken place—but this matter requires further investigation. Then we have the passage of blocks of tin, which had been exposed to intense cold, from the malleable and non-crystalline to a fibro-crystalline and brittle state; in fact, so brittle does the tin become that it more or less completely falls to powder.

The devitrification of glass may also be here mentioned.

6. *Crystallisation by Thermo-reduction.*—I think that we may safely regard the forms exhibited by the artificially produced moss metals as varieties of crystalline forms, and with as much reason as the mineralogist assigns a place for the similar natural forms amongst crystals; the arborescent and other group forms assumed by native metals can be traced from normal and primary forms, such as of the octohedron and rhombic dodecahedron through various degrees of elongation and attenuation until we arrive at the filiform and capillary threads, a number of which aggregated together give the velvet or plush-like mass of moss copper or other metal. Moreover, some portions of the gold reduced from the mispickel showed branching and arborescent groups which had all the appearance of elongated dodecahedra placed end to end, in no way differing from natural specimens except in minuteness and perhaps greater brilliancy of lustre.

But these crystals have been produced by a process differing considerably from the methods enumerated in the first five divisions; hence the necessity for forming the sixth and last group.

The artificially prepared moss metals are produced by a process of reduction, aided neither by vaporisation, solution, fusion, nor electrolysis, neither are they produced "spontaneously," but they are prepared by the aid of a heated reagent. Hence I have for convenience ventured to form a special class, *i.e.*, *crystallisation by thermo-reduction.*

This matter is, of course, very closely connected with the ordinary metallurgical processes of reduction, but in such manufacturing operations no effort is made to obtain the metal in the crystallised state; on the contrary, it is the practice to favour the conversion of the metal into the liquid state as speedily as possible.

Although, perhaps, there may be no true analogy between the two cases, still it would be very interesting to calculate the amount of force requisite to produce the crystals, supposing that they had been mechanically pulled out like wires through a draw-plate, or had been squeezed out through moulds similar to lead tubing.

I hope at some future date to be in a position to supplement the foregoing preliminary notes upon a question which is of great interest and importance in the chemical geology of mineral veins and deposits, when the series of experiments at present in hand are somewhat nearer completion.

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, December 21st, 1876.

The PRESIDENT in the Chair.

THE following notes, descriptive of some of the apparatus exhibited, were read:—

"*Fletcher's Improved Aspirator and Blower*," by J. W. SWAN. This is a modification of the old Sprengel pump, from which it differs in some most important points.

It will give an average duty as a blower of at least double.

It will work with a fall of water so small as to be totally useless for the old form.

The water inlet is arranged so as to throw the water across the descending tube in compact masses, which act as pistons from the moment they enter the tube, and if the air and water are examined as they descend they will be found quite separate and distinct from each other. In the old Sprengel pump, when examined in the same way, the water will be found to form a thick lining to the tube, with a free column of air in the centre, and in the whole length of the tube a large quantity of water can be seen running down the sides, doing absolutely no work.

When a descending tube with a fall of 7 inches is used, it will bear immersion until the water overflow is only one inch below the inlet, and will still deliver air 6 inches below the overflow level. No greater test of the efficiency of this part of the apparatus can be conceived than the fact that a fall of water of three-fourths of an inch will pump air steadily into a tube of five-sixteenths inch bore, or nearly half the diameter of the total fall. Whatever the speed or fall used, the clear definition between the water pistons and the air is equally distinct; and so far as I have tested the arrangement the efficiency as a blower or aspirator is in direct proportion to the difference in level between the inlet and outlet pipes. The air and water at the bottom of the descending tube are delivered against the side of the air chamber, down which the water runs quickly, thus preventing to a great extent the presence of water vapour in the air. As an additional safeguard the air chamber is made very narrow and tall, and at the air outlet near the top is also placed

a spiral water trap. I find that 2 cubic feet of water per hour, with a fall of 2 feet, will supply an ordinary blowpipe with air at a pressure of 12 inches of water. The same quantity of water falling 4 feet will supply two blowpipes, or will supply one with air at double the pressure.

Its efficiency as an aspirator is in proportion, as it perfectly utilises the total height of fall of the water.

The principal points in which this form has an advantage are, its far greater efficiency with a limited supply of water and low fall and the unusual freedom of the air from suspended water and water vapour. It is, in fact, an efficient (cylinder and piston) blower and aspirator working to within a very slight margin of the total theoretical calculated power.

"*Electrical Notes*," by A. Hellisen.

1.—If the primary wire of one Ruhmkorff coil is interposed between the break and the condenser of another (in action) the secondary wire of the first-named coil will show electricity of very high tension which is not subject to the same rules as that of ordinary induced currents. The coil first named may be replaced by two short insulated wires running parallel in zigzag, or being stretched, and still the electricity of the wire that is unconnected will penetrate a space of air when the ends of this wire are approached. Coiling round a core makes the spark brighter but not longer, and the core scarcely shows any magnetism.

2.—Lead may be substituted for carbon in chromic acid cells, and very conveniently combined with it to form constant single fluid cells.

3.—Lead may be electro-plated direct by using a strong solution of silver cyanide and a strong current, and if platinised afterwards furnishes first-rate negative plates for sulphuric acid cells on Smee's principle, that have *no drawbacks*, and will last unchanged any length of time. Lead is recommended for voltaic purposes by being very *manageable*, cheap, and cleanly in contact with sulphuric acid, which cannot be said of graphite, silver, or copper, respectively.

4.—When a piece of copper, bent so as to dip with one end in the upper part of an acid, or a solution of copper, is kept hot by a lamp, while the lower part of the fluid, in which another piece of copper is immersed, is kept cool, a galvanometer uniting these two pieces of copper will indicate a constant current going from the heated plates to the cold (this latter accordingly acting the part of zinc). Lead, graphite, &c., in acids, show the same phenomenon, as far as I have yet tried.

5.—If thin wires, representing the poles of a pile of high tension (I used thirty minute chromic acid cells with lead), are brought one after another in a soot-producing flame (say of a paraffin candle) the wire first in the flame will only cover itself with a thin smooth coating till the other wire is also brought into the flame. Then a very original vegetation will sprout up, tending upwards on both wires, which begins first at the negative pole forming a whole copse of pyramidical shrubs, whereas the positive pole will only a little later emit single long sprouts like cypresses. These agglomerations of soot, even if half an inch long, adhere to the wires afterwards, and when brought in proximity the branches bend to unite and interchange a spark. This very curious phenomenon magnified with a magic lantern would form a very striking public lecture experiment, and, as I never heard of it as such, I conclude it has escaped notice.

"*On Galvanic Cells*," by J. W. Swan. I take the opportunity of publishing, through the medium of the Society, a little fact which I have found very useful in the management of galvanic cells required to be maintained ready for action during a long period. It is the use of a thin stratum of oil on the surface of the liquid with which the cell is charged. It is particularly applicable in the case of the simple carbon and zinc element, charged with solution of chloride of ammonium or chloride of sodium, and much used for electric bells and clocks. The oil covering also tends to conserve the effectiveness of the Leclanché cell. Loss of liquid by evaporation, and by crystallisation on the side and over the edge of the cell, are prevented, insulation is improved, and consequently the energy of the cell is less wasted.

"*Percolator*," by B. S. Proctor. A slight modification of the customary form of percolator, to adapt it to the exhaustion of small quantities of opium, &c., in analysis. It consists of the usual cylindrical tube and receiver, with the addition of a cylinder of tin plate or other suitable material, closed at both ends, fitting loosely within the percolation tube; the object being to get a slightly increased hydrostatic pressure with a small quantity of solvent. The substance to be exhausted, diffused through a small quantity of the solvent, is poured into the glass tube, and then the tin tube being brought down till it touches the top of the liquid, its position is fixed, and more of the solvent is added. As this addition occupies the narrow space between the two cylinders, a head of 6 or 8 inches is obtained with a small quantity of liquid. This arrangement has also the advantage of permitting fresh additions of solvent without their mixing with that portion which by contact with the marc has become charged with extractive.

"*Luting and Washers for Ether, Sulphide of Carbon, or other Volatile Liquids*," by B. S. Proctor.

No. I.

Clay	30
Water	3
Glycerin	8

No. II.

Clay	30
Gum Tragacanth	1
Water	3
Glycerin	8

No. III.

Clay	5
Gelatine	2
Water	2
Glycerin	6

No. IV.

Felt.	
Gelatine	2
Water	2
Glycerin	6

Where a clay luting is required to retain its impervious character for a length of time, the addition of glycerin by preventing its drying imparts that character; but if glycerin and clay alone are used the mass becomes softer by exposure, from the absorption of moisture. In the luting No. I., the glycerin and water are present in such proportion as to give it little tendency o become either harder or softer.

A joint made with No. I., if not kept rigid, ceases to be tight; but No. II. will allow of a little motion, especially if rather more moist. No. III. gives more flexibility, but requires to be applied warm, and of course will not resist heat—even a gentle heat—in use.

The presence of the clay makes the gelatine less fluid while warm, and consequently more convenient in application. Fluidity is still more completely got rid of in the following:—No. IV. takes the form of a washer, and may be applied warm to delicate apparatus, or cold where mechanical pressure can be used freely. It appears to be quite impervious to the vapour of ether. The felt is simply soaked on the melted gelatine and glycerin, and the superfluous quantity pressed or drained out. Corks and bungs may be saturated with the same compound by being boiled in it for half an hour, and kept submerged till the temperature has fallen considerably. If then drained, and the superfluous jelly rubbed off the outside, they are in a condition suitable for stopping vessels of ether, sulphide of carbon, or benzine.

Glass stoppers may be lubricated with this glycerin

jelly in some cases where oily lubricants would be objectionable.

Probably casks might advantageously be lined with a similar compound before being used for petroleum or coal oils.

NOTICES OF BOOKS.

Report to the Secretary of State for the Home Department on the Subject of the Testing of Petroleum. By Dr. F. A. ABEL, F.R.S., Chemist to the War Department.

THE opinion has become very general that the so-called open "flashing-test," as required by the existing Petroleum Act, is unsatisfactory and even fallacious. The chief objection is that it is liable to "manipulation," accidental or designed, *i.e.*, "in consequence of certain very readily variable elements in the details of the test (added to the interfering action of even slight currents of air) the flashing-point of one and the same sample may be made to differ many degrees in the hands of different operators, or of one and the same operator at different times. On this point Messrs. T. W. Keates, Dugald Campbell, the late Dr. Letheby, Drs. Attfield, and B. H. Paul, Dr. Redwood, Secretary of the Petroleum Association, the Secretary of the Scottish Mineral Oil Association, and the local authorities under the Act at Bristol and Liverpool are substantially agreed. It is pointed out that "great difficulties have arisen in connection with the present regulations respecting the testing of petroleum oils, consequent upon the legalised acceptance of oils as safe or their condemnation as dangerous upon a difference of even *one* degree in their flashing-points as determined by a test which may give differences of *several* degrees *with one and the same oil* in the hands of different operators." Prof. Abel has therefore elaborated a so-called "close-test" to be performed with a simple piece of apparatus, which is here described at length and figured, and which has been pronounced satisfactory by Messrs. Keates and Redwood, and also by the Secretary of the Scottish Mineral Oil Association, Mr. B. Calderwood. Prof. Abel's instructions for the application of the test are as follows:—The apparatus should be placed for use in a position where it is not exposed to currents of air.

The heating vessel or water-bath is filled by pouring water into its funnel until it begins to flow out at the spout of the vessel. The temperature of the water at the commencement of the test is to be 130° F., and this is attained in the first instance either by mixing hot and cold water in the bath, or in a vessel from which the bath is filled until the thermometer provided for testing the temperature of the water gives the proper indication; or by heating the water with the spirit-lamp (attached to the stand of the apparatus) until the required temperature is indicated. When a test is completed the water-bath is again raised to 130° by placing the lamp underneath, and the result is readily obtained whilst the petroleum cup is being emptied, cooled, and re-filled with a fresh sample to be tested. The lamp is then turned on its swivel from under the apparatus, and the next test is proceeded with. The test lamp is prepared for use by fitting it with a piece of flat plaited candle wick (*e.g.*, Field's night-light candle wick), and filling it with colza or rape oil up to the lower edge of the opening of the spout or wick-tube. The lamp is trimmed so that when lighted it gives a flame of about 0·15 inch in diameter, and this size is easily maintained by manipulation from time to time with a small wire trimmer. A test-flame arrangement for gas has been devised and may be substituted for the lamp. The bath having been raised to the proper temperature the oil to be tested is introduced into the petroleum cup, being poured in slowly until the level of the liquid just reaches the point of the gauge fixed in the cup. In warm weather the temperature of the room in which the samples to be tested have been kept should be observed in the first instance, and if it exceeds 65° the samples to be tested should be cooled down to about 60° by immersing the bottles containing them into cold water. The lid of the cup, with the slide closed is then put on and the cup placed in the bath or heating vessel. The thermometer in the lid of the cup has been adjusted so as to have its bulb just immersed in the liquid, and its position is not under any circumstances to be altered. When the cup has been placed in the proper position the scale of the thermometer faces the operator. The test-lamp is then placed in position upon the lid of the cup, the lead-line or pendulum which has been fixed in a convenient position in front of the operator, is set in motion, and the rise of the thermometer in the petroleum cup is watched. When the temperature has reached about 66° the operation of testing is to be commenced, the test-flame being applied once for every rise of one degree, in the following manner:—The slide is slowly drawn open while the pendulum performs three oscillations, and is closed during the fourth oscillation.

After careful consideration we have every reason to believe that Professor Abel's method will lead to accurate results—no small boon to the general public as well as to all connected with the petroleum trade.

On Boiler Incrustation and Corrosion. (Read before Section G, British Association, Glasgow Meeting, September, 1876.) By F. J. ROWAN. London: E. and F. N. Spon.

AMONG the various duties which water has now to fulfil, not the least important certainly is to serve for the generation of steam, and its varying fitness for this purpose often occasions no little perplexity. For incrustations a number of remedies have been proposed, some of which, like a quack life-pill, are warranted to answer in all conceivable cases, whilst in reality they are not useful in any. In most cases the author considers soda-ash as the best preventive. Under its influence the sulphate of lime is decomposed, and the carbonate obtained both from this source and from the bicarbonate of lime is deposited as loose powder incapable of forming incrustations. With intelligent supervision there is no fear of any unpleasant results. Where the impurity consists mainly of sulphate of lime the soda-ash may be added to an external feed-tank or cistern instead of into the boiler. Lime and zinc have been successfully used against the bicarbonate of lime, but in case of the sulphate they are useless. Starchy and gelatinous matters, according to the experiments of M. Bidard, rather promote than prevent incrustation. Sodic oxalate and tannate also serve to increase the quantity of the deposit. Sal-ammoniac and hydrochloric acid are very limited in their preventive power, and as might have been foreseen are liable to inflict serious damage on the boiler and its connections. Raw pyroligneous acid has been proposed in case of carbonates existing alone, and for sulphate petroleum has been used with success. But in waters impregnated with carbonate of lime it is not recommended. Soap makes the boilers filthy, sometimes forms a corrosive crust and promotes priming. A process is also in use which turns on the power of chloride of barium to decompose all sulphates present and liberate the carbonic acid in the water. The author, however, holds that for land-boilers the best system is to work in connection with surface condensers, and so supply them with really pure water. This is the more important "in view of the extended use of sectional or water-tube boilers."

Corrosion is apparently a more puzzling phenomenon than incrustation, since it takes places with waters of a high degree of purity, such as the water from Loch Katrine supplied to the City of Glasgow. Carbonic acid and oxygen in solution cause iron to rust away, as was first proved by the late Dr. Crace Calvert, and has been confirmed by more recent observers. The author's con-

cluding remarks are not without significance:—"Apart from such a plan there seems no hope of escaping corrosion and advancing at the same time in engineering practice until it is possible to have copper boilers. And yet, even then, as the recent experiments of Carnelley on the action of water and of various saline solutions on copper (*Chem. Soc. Journ.*, No. clxiii., p. 1) seem to show, we should still have to combat the same difficulties."

We consider that this pamphlet is well worthy the careful attention of chemists, to whom it points out a vast and important field for useful research.

A Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas. London: W. B. King.

We have here before us the first number of a work which promises to be exceedingly valuable. Like many other of the chemical arts the manufacture of gas has undergone of late certain changes which render former treatises on the subject practically obsolete. Hence a new work fully on a level with the practical knowledge of the day is evidently needed, and will doubtless be appreciated. The treatise opens with a sketch of the history of coal-gas—a subject on which misconceptions, if not misrepresentations, prevail to a serious extent. Next will follow a full account of the geology, lithology, and chemistry of coal; the raw material, and a description of the properties, manufacture, and purification of the gas produced. Then will come a notice of the manufacture of illuminating gas from other materials, and of methods of lighting proposed to supersede gas altogether. Lastly, the disposal and utilisation of the residual products are to be taken into consideration.

The historical section opens with a few remarks on the dawn of our knowledge of the gaseous bodies—a subject which, if touched upon at all, might have been handled with more accuracy and comprehensiveness. The earliest notice of a gaseous hydrocarbon occurs, we are told, in a paper communicated to the *Philosophical Transactions* in 1667, by Thomas Shirley, describing his observations made in 1659 upon the so-called "Burning Well," near Wigan. In this paper experiments are described proving that the combustion was due, not, as was commonly believed to the water itself, but merely to a gas escaping through the water. The next step was taken by Dr. John Clayton, Dean of Kildare. His paper is inserted in the *Philosophical Transactions* for 1739, and is without a date. But the original manuscript in the British Museum is addressed to Robert Boyle, who died as early as 1691. Hence Clayton's observations must have been made not long after those of Shirley. Visiting Wigan and examining the well, which had become much feebler, he caused the water to be dammed out, and digging to the depth of half a yard found a bed of shelly coal, the air escaping from which was found to be combustible. He did not, however, stop here. He submitted coal to destructive distillation and obtained a combustible gas; he describes, in short, in his paper "the means of storing this gas, the pressure necessary to expel it to be inflamed, the facility of lighting and extinguishing, and the possibility of its being kept for a considerable time without losing its inflammability." He advanced, in fact, our knowledge of coal-gas to such a point that all was ready for an applier to step in, manufacture it on a large scale, and turn it to account. Even, therefore, had Lebon anticipated Murdoch, the discovery of coal-gas would still belong to this country,

The researches of Priestley, Black, and Cavendish are next described, and the authors then pass on to a notice of Murdoch, the first practical applier of coal-gas. Whilst living at Redruth, in 1792, he engaged in experiments on the production of coal-gas, and on the cost of the light thus obtainable in comparison with the cost of illumination by lamps and candles. In 1797, he "lighted his premises at Old Cumnock, in Ayrshire, with coal-gas, exhibiting the light to numerous spectators," and in 1798 he erected an apparatus at the Soho Foundry, Birmingham, lighting up one of the buildings for several successive nights, and trying various methods of purifying the gas.

We must now turn to Le Bon or Lebon, whom certain French and American authorities consider as the inventor. His patent was not taken out till 1799, and we may observe that inventors about to take out a patent are as a rule very cautious not to publish their ideas previously. There was, moreover, exceedingly little communication at that time between France and England. To assume, therefore, without the shadow of evidence, that Murdoch derived any assistance from Lebon is utterly unjustifiable. Lebon's specification, further, which is quoted in the work before us, proves that his apparatus is "of the most impracticable kind," and that "he had no definite idea or system with reference to the application of gas, either for lighting or heating." He also states that "either wood, coal, oil roots, grease, or other combustible matters can be employed, the results being always the same." These words alone are sufficient to show that his knowledge of gas was crude in the extreme. Even in his certificate of additions, obtained in 1801, it still appears that his main object was to obtain motive power by the explosion of inflammable gas when mixed with atmospheric air.

It is therefore evident that the honour of the practical application of coal-gas as a source of light belongs to Scotland.

One question here suggests itself to our mind: Is it because Murdoch was by profession an engineer that the manufacture of gas, which, abstracting from the subsidiary process of its distribution, is essentially a chemical art, has fallen completely into the hands of a body of engineers?

CORRESPONDENCE.

DOCTORS' DIPLOMAS.

To the Editor of the Chemical News.

Sir,—Some time ago there appeared in a Portuguese paper an advertisement very similar to the one referred to by Dr. Austen; it was rather more explicit, however, and stated that the diplomas were to come from the University of Jersey.

"Medicus" may obtain his from some place having a more material existence, but if so, he does not obtain them in Jersey.—I am, &c.,

Thos. M. Morgan,
Professor of Chemistry, Victoria College, Jersey.
February 6, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Justus Liebig's Annalen der Chemie,
Band 184, Heft 2.

Contributions to the Theory of Luminous Flames.—Dr. Karl Heumann.—In this interesting essay the author demonstrates the existence of solid carbon in the luminous flames of the hydrocarbons. Chlorine imparts a considerable luminous power to the feebly luminous or non-luminous flames of hydrocarbons. As chlorine at a red heat separates solid carbon in the form of soot from the hydrocarbons, the luminosity thus produced must be due to solid particles of carbon. A slender rod held in the luminous flame is coated with soot almost exclusively on the lower side exposed to the stream of gas, proving

that the soot impinges against the rod in a solid state. If the luminous flame surrounding the rod on all sides contained the soot as a vapour, the smoking would be a condensation—and effect of cooling—and would take place on all sides of the rod, which is not the case. Deposition of soot is observed on strongly ignited surfaces, which would not be possible if it were the condensation of a vapour, and therefore due to cooling. Just as the separate particles of carbon in an ascending column of soot only become visible to us when the exceedingly minute and numerous corpuscles are agglomerated into somewhat larger masses in consequence of impact against quiescent strata of air or solid bodies, and have lost a part of their speed, in like manner the particles of carbon in luminous flames can be rendered visible if the flame is caused to come in collision in a suitable manner with another flame or with an ignited surface. The separated particles of carbon come in mutual collision, and unite to larger and less numerous masses, so that the luminous mantle of the flame appears scattered over with innumerable luminous points. The smoke of such a flame is very coarsely granular. The luminous stratum of a flame is not transparent in a high degree, and is the more opaque the greater its thickness and the more particles of carbon it contains. The transparence of a luminous flame is not greater than that of a smoke column of equal thickness arising from the flame of burning oil of turpentine, and filled, as is well known, with solid particles of carbon. The flame of hydrogen charged with chloro-chromic acid, and indubitably containing solid chromic oxide, is quite as transparent as the flames of hydrocarbons. Flames which notoriously owe their luminous power to the presence of finely-divided solid matters cast a characteristic shadow in the sunshine. Luminous flames consisting merely of incandescent gases and vapours give no shadow, but merely lighter and darker bands or clouds, due to the refraction of light. Luminous hydrocarbon flames throw in the sunshine a well-defined and intense shadow, consequently they contain a solid in a state of minute division. This solid can be nothing but carbon, as follows from the absence of other solids capable of bearing ignition.

Band 184, Heft 3.

Action of Phosphoric Pentachloride upon Phenyl- and Para-Toluyl-Oxamethan.—H. Klinger.—PCl_5 acts upon amides, according to the old view of Gerhardt, the experimental confirmation of which was hitherto wanting—$CONHR + PCl_5 = CCl_2NHR + POCl_3$. This confirmation was also furnished by Wallach, who prepared the amide-chloride of oxamethan. If gently heated, or treated with gaseous ammonia, amide-chloride loses 1 molecule of HCl, and becomes an imide-chloride. With water, aqueous alkalies, and aniline, amide- and imide-chlorides behave qualitatively perfectly alike. The introduction of the phenyl group into the amidic residue of oxamethan prevents the formation of basic bodies. The action of the phenyl-residue is not annulled when one of its hydrogen atoms is replaced by the radical CH_3. In the author's experiments the groups CH_3 and NH occupied the para position.

A Contribution to the Knowledge of the Thiamides of the Monobasic Organic Acids.—Dr. Aug. Bernthsen.—This paper comprises an examination of phenyl-aceto-thiamide, its transformations, its behaviour with nascent hydrogen, the reduction of benzyl-cyanide by nascent hydrogen, the action of iodine upon phenyl-aceto-thiamide; the behaviour of phenyl-aceto-thiamide and other thiamides with ammonia and amine bases; and an account of the constitution of the thiamides. There is also an appendix treating of phenyl-acetamide.

New Methods of Preparation of the Amidins of Monobasic Organic Acids.—Dr. Aug. Bernthsen.—A lengthy paper, not adapted for useful abstraction.

Determination of Nitrogen by Will and Varrentrapp's Method.—C. Makris.—The sources of inaccuracy are the possible dissociation of ammonia at high temperatures, and the combustion of a part of the ammonia when air is drawn through the apparatus at the end of the operation. These causes of error, according to the author, may be avoided by not allowing the temperature to rise above dull redness; by taking care that the ammoniacal gas is sufficiently diluted as it passes over the ignited soda-lime; and by drawing through the combustion-tube at the end of the operation, not atmospheric air, but some indifferent gas. He takes a combustion-tube 60 centimetres in length, not drawn out to a point, but rounded off at the end, and introduces, first, 0·3 grm. of sugar free from nitrogen, and mixes it by shaking with about twenty times its weight of soda-lime in powder. Upon this follows a stratum of granulated soda-lime 12 centimetres in length, then 3 centimetres of powdered soda-lime; then a mixture of the substance under analysis (say 0·2 grm.) with 0·3 grm. sugar and powdered soda-lime; the tube is then filled in the ordinary manner with granulated soda-lime, followed up with the asbestos plug, and cork as usual. At first the anterior layer of pure soda-lime is heated to dull redness; then the stratum of soda-lime between the sample and the mixture of sugar and soda-lime at the back of the tube; then finally the sample, so that a slow but continuous current of gas is kept up. When the escape ceases, the mixture of soda-lime and sugar at the back of the tube is heated so as to sweep the residual ammonia out of the tube.

Gazzetta Chimica Italiana.
Anno vi., 1876, Fascicolo ix.

Function of Chlorophyll in the Vine.—Giovanni Briosi.—A preliminary notice.

Nitro-Derivatives of Salicylic Aldehyd.—G. Mazzara.—The author has resumed the study of this compound, first examined by Lœwig in 1836, and finds that the action of nitric acid upon salicylic aldehyd gives rise to two isomeric mono-nitro-derivatives of a strongly marked acid character.

Reciprocal Action of Iodide of Potassium and of Sulphate of Lead.—Prof. G. Campani.—Iodide of potassium in solution forms with sulphate of lead iodide of lead and sulphate of potassa. With phosphate of lead the same transformation occurs.

Detection of Manganese in Ashes in the State of Phosphate.—Prof. G. Campani.—Manganese may occur in ashes in the state of oxide or of a salt. When there are sufficient phosphates in the ash it is treated with an excess of hot aqua regia, the liquid filtered, and evaporated to dryness in a porcelain capsule on the water-bath. If the ash contains manganese the residue presents an amethyst or violet colour, more or less intense, according to the quantity of the phosphate of manganese produced. As all ashes do not contain phosphates, the author finds it useful to treat with a mixture of 15 c.c. of syrupy phosphoric acid and 85 c.c. of nitric acid.

Detection of Picric Acid in Beer.—Dr. Dioscoride Vitale.—The author agitates 10 c.c. of the suspected beer in a test-tube with half its volume of pure amylic alcohol. If the mixture is left to settle, the amylic stratum separates entirely, and is drawn off with a pipette, evaporated to dryness at a convenient temperature in a porcelain capsule, and the residue is finally taken up in a little distilled water with the aid of heat. The aqueous solution is divided into portions, and submitted to the following reagents. One portion is treated with a solution of the ammonio-sulphate of copper, which in dilute solutions of picric acid instantly produces a turbidity, due to the formation of very minute crystals of the ammonio-picrate of copper of a greenish colour. Another portion may be tested with a concentrated solution of cyanide of potassium, which produces a blood-red colour, more or less intense, according to the quantity of picric acid present, in conse-

quence of the formation of iso-purpuric acid. A third portion may be submitted to the action of sulphide of ammonium, rendered still more alkaline by the addition of a few drops of ammonia. Here, also, a blood-red colour is produced, which becomes more intense on the application of heat, and is due to the formation of picramic acid.

Anno vi., 1876, Fascicolo x.

Chemistry at the Fifth Reunion of the Russian Men of Science.—The substance of the chemical papers read at this meeting is noticed elsewhere.

Researches on Picrotoxin.—E. Paterno and A. Ogliaioro.—The analysis executed by the authors gave—

Carbon	59·38
Hydrogen	5·44

which agrees with the formula $C_9H_{10}O_4$ better than with $C_{12}H_{14}O_5$.

Researches on Cumophenol.—E. Paterno and E. Spica.—A description of cumophenol, its methylic ether, and its acetylic derivative.

Assay of Zinc Ores.—The electrolytic method first applied by Luckow to the assay of copper, cobalt, and nickel ores has been successfully applied to ores of zinc in the laboratory of Antonino Mascazzini.

Declaration.—T. Brugnatelli.—The author gives notice that he does not intend to accept any responsibility for the views of Prof. Lombroso on the alkaloid present in decaying maize, and leaves to him the entire merit.

Researches on Essence of Turpentine.—G. Papasogli.—Not suitable for condensation.

Specific Heat of Carbon, Boron, and Silicon.—F. Weber.—Already noticed.

Bulletin de la Societe Chimique de Paris,
No. 11, December 5, 1876.

Synthesis of Allantoin.—M. E. Grimaux.—Allantoin may be obtained by heating 1 part of glyoxylic acid and 2 parts of urea for eight to ten hours to 100°. The mass is taken up with four times its weight of boiling alcohol, and the residue, insoluble in alcohol, is dissolved in twelve to fifteen times its weight of boiling water. The crystals formed are purified by re-dissolution in water.

Process for the Detection of Magenta in Wine.—M. Fordos.—Already noticed.

Determination of the Dry Residue of Wine.—M. L. Magnier de la Source.—The author operates on 1 grm. of the sample, which he evaporates in a dry vacuum, and weighs after the lapse of four days in summer and five or six in winter.

Disengagement of Hydrogen during the Action of Zinc upon Copper Sulphate.—M. L. Meyer.—Leykauf, who observed this phenomenon in 1840, thought it was attended with the production of cuprous oxide. The author finds, however, that there is a formation, not of cuprous oxide, but of basic sulphate of zinc.

Decomposition of Solutions of Potassic Alum at 100°.—M. A. Naumann.—If aqueous solution of alum is raised to 100° there is gradually formed a white precipitate, which, when washed with water, forms an amorphous powder mixed with brilliant laminæ, sparing soluble in hydrochloric acid, but readily soluble in potassa. The composition of this precipitate is not constant; it contains from 31·2 to 32·6 per cent of alumina, 11 of potassa, and 30 to 40 of sulphuric acid, besides water. It is therefore a basic salt approaching alunite. The formation of this salt is promoted by the presence of sulphate of potassa, but it is entirely hindered by the addition of an excess of sulphuric acid.

Structure and Generation of the Aromatic Colouring Matters.—Otto N. Witt.—The conclusions of the author are—The tinctorial power of aromatic bodies is determined by the simultaneous presence of a colouring group (*chromophore*), and of a salifiable group (*chromogene*) The chromophore exercises its influence on the saline combinations of the colouring matters more than on these same bodies in a free state. Of two colouring matters of the same structure the most solid is that whose salts are the most stable.

Facts Relating to Rosolic Acid.—MM. Liebermann and Schwarzer.—The colouring matter formed by the action of concentrated sulphuric acid upon salicylic aldehyd is easily formed. It is best to heat the mixture for an instant in the water-bath. The product dissolves in alkalies with a red colour verging upon violet; acids precipitate it anew in red flocks. It is analogous to rosolic acid, but is distinguished by the slighter solubility of its magnesian salt, by the red colour of its salts, and of the precipitate determined by acids.

Les Mondes, Revue Hebdomadaire des Sciences,
December 28, 1876.

A plant growing in Tonquin, and named *Hoang-nan*, is announced as a cure for leprosy, cancer, and the bites of venomous animals.

Solidification and Saponification of the Oil of Petroleum.—Petroleum, in consequence of an admixture due almost entirely to chance, acquires the consistence of stearin, and whilst preserving all its illuminating power becomes perfectly inexplosive. As a soap this solidified petroleum has the same detergent properties as benzol.

Several chemical papers in this issue are taken from English sources.

Reimann's Farber Zeitung.
Nos. 47, 1876, and 1, 1877.

These issues contain nothing of general interest.

NOTES AND QUERIES.

Sulphuric Acid free from Arsenic.—Mr. H. Hasperg, of the *Chemische Producten Fabrik*, Hamburg, has learned that in many English sulphuric acid works there has been introduced a newly invented arrangement, by which arsenic is got rid of, so that the acid is absolutely free from arsenic. He desires to know full particulars, or the name of any person in England who can give him the wished-for information.

The History of Chemistry.—(Reply to "Enquirer")—Consult Roswell's "Birth of Chemistry:" Macmillan. See also "Bibliography of the History of Chemistry," by H. Carrington Bolton: Chemical News, vol xxxii., pp. 36, 56, 62.—A.

MEETINGS FOR THE WEEK.

Monday, 19th.—London Institution, 5.
—— Medical, 8.
Tuesday, 20th.—Royal Institution, 3. Prof. Garrod, "On the Human Foot: its Structure in Relation to its Contour."
—— Civil Engineers, 8.
—— Zoological, 8.30.
Wednesday, 21st.—Society of Arts, 8. Sir John Lubbock on "Certain Relations between Plants and Insects."
—— Meteorological, 7.
—— Geological, 8.
Thursday, 22nd.—Royal, 8.30.
—— London Institution, 7.
—— Philosophical Club, 6.30.
—— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
—— Society of Arts, 8. (Chemical Section) "Spontaneous Combustion in Factories and Ships," by C. W. Vincent, F.R.S.E.
—— Zoological, 4.
Friday, 23rd.—Royal Institution, 9.
—— Quekett Club, 8.
Saturday, 24th.—Royal Institution, 3. Prof. H. Morley on "French Revolution and English Literature."

PATENTS.—Mr. Vaughan, F.C.S., British Foreign, and Colonial PATENT AGENT. Special attention given to Inventions relating to Chemistry, Mining, and Metallurgy. "Guide to Inventors" Free by Post.—Offices, 67, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

THE CHEMICAL NEWS.

Vol. XXXV. No. 900.

ANALYTICAL NOTES.

By SERGIUS KERN, St. Petersburg.

1. *On the Estimation of Carbon.*

The best method for estimating carbon in pig-iron and steel is the copper chloride process. The results obtained by this method are quite satisfactory for metallurgical purposes. The following remarks from my own practice may be of some use to analysts.

1. In analysing pig-iron it is quite enough to take 0·2 to 0·3 grm. of the specimen; in analysing irons and steels 2 to 3 grms. In preparing copper chloride, the solutions of copper sulphate and sodium chloride must be neutral and heated to 35°. For dissolving every 0·1 grm. of the specimen 20 c.c. of concentrated copper chloride solution is used.

2. The glass with specimen and copper chloride solution is left for two days at the ordinary temperature; every three or four hours the solution is carefully stirred with a glass rod. When no coarse particles remain on the bottom of the glass the solution is placed on a sand-bath and gently heated to 50° to 60° for about three hours. An excess of hydrochloric acid is next added and the analysis is concluded in the ordinary way.

3. Pig-irons containing manganese in notable quantities are dissolved entirely in copper chloride in about 6 to 8 days; ferro-manganese requires not less than 10 days.

4. The filtration through asbestos filters must be always executed as quickly as possible; in this case Weil's apparatus is very handy. The construction of it is described in Dr. Fresenius's "Quantitative Analysis" (sixth edition).

2. *Platinum Crucibles.*

These crucibles are not so often washed and cleaned in laboratories as is necessary. For a month experiments were made with a crucible, washed and cleaned before commencing the following experiments every month not more than four or five times.

		Grammes.
October	1, crucible weighed.. ..	20·6490
,,	5, ,, ,, ...	20·6485
,,	10, ,, ,, ...	20·6481
,,	15, ,, ,, ...	20·6479
,,	20, ,, ,, ...	20·6478
,,	25, ,, ,, ...	20·6476
,,	30, ,, ,, ...	20·6475

During this month every day two or three ignitions were made; after every ignition the crucible was washed by hot water acidulated by 10 per cent of nitric acid and dried on a spirit lamp. From the above-mentioned table it is seen that in a month the crucible lost in weight 0·0015 grm. In the same time another crucible weighing 20·6852 grms. every day was carefully washed by melting in it $HNaNH_4PO_4$, and next well polished with silica sand. This crucible had all the time a smooth bottom, and lost in weight during a month, in which it was used every day for ignitions, only 0·0006 grm.

My opinion is that platinum crucibles with a rough surface combine more quickly with the carbon of the flame than do crucibles with smooth surface. I also remarked that the sulphur (SO_2,H_2S) of the gas has a great influence on platinum, so that it was found better to purify the gas by $Pb(NO_3)_2$ in NaHO before allowing it to pass in the Bunsen burner.

Obouchoff Steel Works, St. Petersburg.

ON THE GASES CONTAINED IN METEORITES.

Second Paper.

By ARTHUR W. WRIGHT, Yale College.

In a previous article, published in the *American Journal of Science and Arts*, April, 1876, the writer gave the results of investigations upon the nature of the gases evolved from a number of meteorites of both the iron and the stony classes, when exposed to a more or less elevated temperature. The stony meteorites examined were all of the more common type, containing a considerable percentage of nickeliferous iron, without any appreciable quantity of uncombined carbon. As is well known, however, among these bodies of the stony kind, the meteorites of Alais, Kold Bokkeveld, Kaba, and Orgueil, form a distinct class, differing from the rest in several particulars, and especially in containing considerable proportions of amorphous carbon, and a bituminous substance consisting of carbon combined with oxygen and hydrogen in such a way as to simulate organic products. They are further distinguished by containing only very small quantities of metallic iron. As it seemed of interest to determine whether the conclusions arrived at in the investigations previously described were applicable to the bodies of this peculiar class also, the work was continued, with the results given below. Several other points of importance, referred to in the previous paper, were investigated, and are discussed in subsequent paragraphs.

The material used for the determinations was a fragment of an excellent specimen of the Kold Bokkeveld meteorite in the cabinet of Yale College. It contains an inconsiderable proportion of metallic iron, though this is not entirely absent, for, on filing away the surface, very minute particles may occasionally be seen. The analysis made by Harris* gives for the carbon 1·67 per cent, and for bituminous matters 0·25 per cent. As has been shown by Prof. J. L. Smith,† the mineral constituents are not greatly different from those of the ordinary stony meteorites. The method employed for the evolution and collection of the gases was essentially the same as that described in previous papers, and need not be given in detail here. It is sufficient to mention that, as the meteorite gives off a large amount of water on being heated, the tube containing the substance was connected with the pump by a recurved tube, the bend of which was placed in a freezing mixture during the evolution of the gas, in order to collect the water and prevent it from entering the pump. This tube was sealed with a gas-flame at the close of the experiment, and the water retained for examination. The temperatures employed for driving off the gaseous contents were nearly the same as those of the previous experiments, being however slightly lower, in order to avoid, as far as possible, complication of the results by the action of the heat upon the bituminous matter. The results were as follows:—

Kold Bokkeveld.

	CO_2.	CO.	CH_4.	H.	N.	Volumes.
300°—350°	87·34	5·08	5·93	trace ?	1·65	7·45
500°	95·53	1·32	2·14	0·54 ?	0·47	17·78
Total ..	93·11	2·42	3·25	0·38 ?	0·84	25·23

The volume of the gases obtained is much greater in this than in the previous determinations; but it will be seen that in its composition the gaseous mixture is similar to that derived from the ordinary stony meteorites, with the exception of the hydrogen, of which, if any was present, the quantity was so small as to make its determination a matter of some uncertainty. The percentage of carbon dioxide is somewhat larger at the higher temperature than in the other cases, but the real difference here is less than it appears, as the increase in the quantity of

* C. Rammelsberg, "Die chemische Natur der Meteoriten." *Abhandl. der Königl. Akad. zu Berlin.* 1870.

† *Amer. Journ. of Science and Arts*, Ser. III., xi., p. 391.

Iron Meteorites.	CO_2.	CO.	CH_4.	H.	N.	Vols.	Observers.
Lenarto	4·46	0·00	—	85·68	9·86	2 85	Graham.
Augusta Co., Va.	9·75	38·33	—	35·83	16·09	3·17	Mallet.
Tazewell Co., Tenn. ..	14·40	41·23	—	42·66	1·71	3·17	W.
Shingle Spr., Cal.	13·64	12·47	—	68·81	5·08	0·97	W.
Texas	8·59	14·62	—	76·79	0·00 ?	1·29	W.
Dickson Co., Tenn... ..	13·30	15·30	—	71·40	0·00 ?	2·20	W.
Arva	12·56	67·71	—	18·19	1·54	47·13	W.
Stony Meteorites.							
Iowa Co.	49·51	2·64	0·00 ?	43·03	3·92	2·50	W.
Guernsey Co., Ohio ..	59·88	4·40	2·05	31·89	1·78	2·99	W.
Pultusk	60·29	4·35	3 61	29·50	2·25	1·75	W.
Parnallee	81·02	1·74	2·08	13 59	1·57	2·63	W.
Weston	80·78	2·20	1·63	13·06	2·33	3·49	W.
Kold Bokkeveld	93·11	2·42	3·25	0·38 ?	0·84	25·23	W.

hydrogen evolved at the higher temperatures, from the specimens which contained metallic iron, produced a corresponding diminution in the percentage of the carbon dioxide; neglecting this, the proportions would show a much closer correspondence. It seemed probable that, at least at the higher temperature, an appreciable quantity of some hydrocarbon of the olefiant series—that is, with more carbon atoms than are contained in marsh-gas—might be found. But both the analyses and special tests of the gas with fuming sulphuric acid showed that the quantity of such substances possibly present was too small to carry it beyond the range of the ordinary errors of observation. The bituminous substance would thus appear to have been simply volatilised by the degree of heat employed, and condensed again in the cooling tube without decomposition. No attempt was made to collect it separately.

The amount of water driven off by the heat and collected in the cooled tube was found to be about 10 per cent of the weight of the substance employed, but the determination was not entirely satisfactory. Faraday found for the water 6·5 per cent. Wöhler states that the powder dried at 120° lost 10·5 per cent more by stronger heat. Rammelsberg found that the total loss at a strong heat was 15·24 per cent; but this of course includes, besides the water, the gases evolved and the volatile bituminous substance, as well as some sulphur, which was observed to be volatilised. The water, on the application of the ordinary tests, gave distinct evidence of the presence of chlorine, and less certainly of sulphurous oxide, resembling in these respects that derived from other meteorites. A small quantity of a light yellowish substance was deposited in the cold part of the tube, which appeared to be sulphur, but was not specially examined.

The differences in the gaseous products obtained from meteorites of the different classes may be made more apparent by bringing together the results of analyses hitherto made. The following table gives the total percentage of the gases yielded by the different specimens, the first seven being irons, the remainder belonging to the stony class. It represents the composition of the total amount of gas given off up to incipient or low red-heat, except in the first two instances where the temperature employed was much higher.

In the case of the last of these meteorites the number given in the table does not express the whole volume of gas contained in it, as the experiment was discontinued before it ceased to be given off. A special determination made with a separate portion gave a little more than thirty volumes. The Arva meteorite also is exceptional both as regards the volume of gas yielded by it and with respect to the large volume of the carbonic oxide obtained. We are reminded, by this fact, of the Ovifak iron, from which Wöhler obtained, by heating it to redness in an iron tube, more than 100 volumes of gas which was found to be carbonic oxide mingled with a little carbon dioxide.* He attributes it, however, to the action of the carbon upon some oxygen compound, and the mass was found to contain a large quantity of magnetic oxide of iron. Doubtless the result was affected by the employment of the iron tube, which would rapidly reduce the carbon dioxide at such a temperature. Berthelot, who examined another portion, at M. Daubrée's request, obtained, by slow calcination in a tube of Bohemian glass, a large volume of gas, the precise amount of which is not stated, consisting chiefly of the two oxides of carbon in nearly equal quantities.† The celestial origin of the Ovifak iron is very doubtful, however, and its composition is different from that of the Arva meteorite, in which no oxygen compounds were detected.

A few words need to be said with reference to the volumes quoted in the case of the Tennessee, Texas, and Arva irons. In an article published in the *American Journal of Science and Arts*, for April, 1875, giving an account of a spectroscopic examination of the gases from these bodies, it was stated that the volumes were as follows:—Tennessee, 4·69; Texas, 4·75; Arva, 44+; whereas the volumes as determined in the subsequent investigations by actual measurement were 3·17, 1·29, and 47·13 respectively, as given in the table. The discrepancy is due to the fact that the former numbers were calculated from the change in the reading of the gauge of the air-pump on evolution of the gas, and were not corrected for the small amount of water vapour present. Where the quantity of gas was small the error from this source was considerable, and the result would have only the value of a rough estimate. In the case of the Arva iron, where the volume of the gas was much larger, the inaccuracy was not serious, and the volume corresponds much more nearly with the true result as obtained from measurement. In the later determination of the volume of gas from the Texas iron, moreover, the metal was in rather coarse fragments, and the evolution of gas from it was not as complete as in the previous case. That the amount of gas obtainable from this iron should approximate to that obtained from the Tennessee specimen, if the trial were made with finely pulverised metal, is clearly indicated by the results of the earlier experiments.

The necessity for the precautions mentioned in the previous paper respecting the degree of heat employed and the time of its application, was well shown in the repetition of the experiments with the Iowa meteorite. The reducing action of the metallic iron upon the carbon dioxide, though not very apparent at comparatively moderate temperatures, becomes considerable as the temperature rises, and in some of the experiments where the heat was carried nearly to redness, and prolonged beyond what was necessary for the evolution of the larger part of the gas it was found that the amount of carbonic oxide was very variable, in one instance reaching to 12 or 13 per cent. This explains also the larger amount of this gas obtained in the preliminary examination of last year, where the analysis gave 14 per cent, as no special attention was at that time given to this source of error. It is also clearly

* *Pogg. Ann.*, 146, p. 295.

† *Comptes Rendus*, lxxiv., 1545.]

shown by the following experiment with a portion of the Weston meteorite. After the gas had been driven off from this by a red-heat, pure dry carbon dioxide was admitted into the pump, and the tube heated nearly to redness for about half an hour. On pumping out some of the gas and analysing it, it was found that nearly 20 per cent of it had been converted into carbonic oxide. Although great care was taken in all the subsequent work to avoid this source of inaccuracy as completely as possible, the percentages of this gas obtained at the higher temperatures are less certainly to be depended upon than the others. The amount of marsh-gas obtained also shows a certain correspondence with that of the carbonic oxide, as if—possibly in the reaction by which the carbon dioxide was broken up by the iron—a portion of the carbon combined with the hydrogen present to form marsh-gas, a supposition which is not without warrant from the conclusions of other observers.* But though some degree of uncertainty may attach to the numbers given for the higher temperatures, the fact that, with all the precautions observed in the experiments, the gases were found to be present in small quantities, even at the lowest temperatures at which examination was made, renders it probable that the results are not far from the truth, and that carbonic oxide and marsh-gas are really to be reckoned among the gaseous contents of the stony meteorites, and that the same cause which produced the one in greater or less quantity had a similar effect upon the other.

Among the questions discussed in the previous paper was the manner of the occurrence of the carbon dioxide. This has been subjected to further examination, with the result of modifying somewhat the conclusions there arrived at. That it has been derived from the atmosphere by absorption subsequently to the fall of the body is improbable; for not only did the re-examination of the Iowa meteorite show a loss rather than gain with the lapse of time, but also there would seem to be little reason for a selective action of the mass, which would enable it to take up this gas in preference to the other atmospheric constituents, unless it were the fact of the feebly acid character of the carbon dioxide, as in the presence of or combined with water. But in this case the carbonates formed by combination with the oxides present in meteoric masses would be very stable compounds, and quite incapable of decomposition at the low temperatures employed.

The explanation was suggested in the earlier papers that the gas was condensed upon the finer particles of the metallic iron, as well as absorbed within it. With a view to test the correctness of this supposition, a special set of experiments was undertaken. A quantity of the substance of the Iowa meteorite was reduced to fine powder, and the iron extracted from it with a magnet, and kept by itself. The grains of iron were then rubbed repeatedly in an agate mortar, to free them as completely as possible from the adhering stone, from which they were separated as before, the residue of the powder being added to that left by the first operations. The material was thus divided into two portions, one of which consisted chiefly of the stony matter, the other principally of the iron. For a third portion pieces of the meteorite were simply broken into small fragments, and not pulverised. Each portion was placed in a clean tube, and in its turn attached to the pump for examination, care being taken to subject each, as nearly as was possible, to the same degree of heat and for the same length of time. The highest temperature employed was below that of red-heat. The following were the results obtained:—

	CO_2 and CO.	H.	N.	Volumes.
Powder ..	66·96	30·96	2·08	0·97 } 1·48
Iron	38·72	59·38	1·90	0·51 }
Fragments ..	48·07	50·93	1·00	1·87

Although, from the nature of the case, no very precise result could be expected from this mode of experiment, inasmuch as it was impossible either to separate the iron entirely from the mineral portion, or to free the iron completely from the stony matrix, the numbers above given indicate clearly that the stony portion yields a considerable portion of the gas given off at the temperature employed, and that this contains a larger proportion of the carbon oxides than that obtained from the iron, which, on the other hand, is richer in hydrogen. The product of the stony fragments is, in its composition, approximately a mean between the two others, as was to be expected; but it will be seen that the volume obtained was somewhat larger, showing that a portion of the gas was lost in the process of pulverisation. These facts would seem to indicate that, while a portion of the gas may be condensed upon the fine particles of the iron, as at first conjectured, a large part of the carbon dioxide, and possibly also of the water, carbonic oxide, and other gases, is mechanically imprisoned in the substance of the meteorite. Now Mr. Sorby has shown* that the meteorites of Aussun and Parnallee, when examined in thin sections under the microscope, contain numerous small cavities filled with gas, similar to those which have been observed in many terrestrial minerals. It will be noticed that the Parnallee meteorite was one of those examined by the writer, and found to yield 2·63 volumes of gas on the application of heat.

The occurrence of carbon dioxide in cavities of minerals, under a pressure so great as to cause it to be in the liquid condition, as also associated with water, has been often observed, and has been quite recently proved in an ingenious and satisfactory manner, by Mr. Hartley,† for a large number of different minerals. Similar gas-cavities have been shown also to exist in many eruptive or volcanic rocks, for examples of which we need only to refer to Mr. Sorby's and Mr. J. C. Ward's papers in the *Quarterly Journal of the Geological Society*, and to other memoirs published elsewhere. The actual extraction and chemical examination of the gaseous contents of these bodies appears to have attracted little attention thus far, though they might lead to results of great interest and importance. Some incomplete experiments by the writer may be mentioned here, as illustrations, though but little weight is attached to them as quantitative determinations. A quantity of pulverised trap-rock was subjected to a heat which was raised to incipient redness, the examination being conducted by the same method as that employed upon the meteorites. The mineral gave off about three-fourths of its volume of mixed gases, which were found to contain about 13 per cent of carbon dioxide, the residue being chiefly hydrogen. Another specimen of trap, containing small nodules of anorthite, was examined, at the request of Mr. G. W. Hawes, who had observed gas-cavities in a thin section of the mineral prepared for microscopic examination. This gave off somewhat more than its own volume of gas, which was found to contain some 24 per cent of carbon dioxide. The gas in these cases was not given off as readily as from the meteorites, and was evolved rather sudden[illegible] at a temperature approaching red-heat was reached. If it should appear improbable that the large amount of gas contained in the Kold Bokkeveld specimen could be retained in this way, it may be suggested that the amorphous carbon contained in it is a substance peculiarly fitted to absorb and retain large volumes of gas. These results would seem rather to assimilate the stony meteorites to terrestrial rocks of volcanic origin, than to place them in a different category, and to strengthen the evidence that they are themselves the product of igneous action, though modified profoundly in some respects in their structure, by the influence of other forces and the circumstances of their formation. The supposition of the imprisonment of the gas in the stony substance would also serve to explain why the water, which cannot be separated by a temperature of 100°, con-

* Watts's "Dictionary of Chemistry."

* *Proc. Roy. Soc.*, June 10, 1864.

† CHEM. NEWS, June 6, 1876, p. 237.

tinues to be given off even at the highest temperatures employed, as has often been observed in experiments with meteorites.

It has been pointed out by astronomers that on arranging the mean distances of the asteroids in a series, there are found to be certain gaps in the list, as if some members were wanting. Now it is further found that the periodic times of these missing bodies stand in a simple relation to the time of Jupiter's revolution, and in such a way that his continued action upon them would accumulate the perturbative effects, tending to throw their orbits into eccentric forms. Such of the bodies as were caused to move in very narrow orbits, with shortened period, would be exposed to very great vicissitudes of temperature, and during the part of the orbit near the sun not only would the change of temperature be comparatively rapid, but the actual degree of temperature reached would be very considerable, especially considering the fact that these bodies are of too small mass to permit them to retain an atmosphere of any appreciable amount. It is not difficult to see that these great changes of temperature, in a mass of considerable absorptive and low conducting power, must give rise to powerful stresses, and that under the intense action of the sun near the perihelion the action may be sufficiently energetic to cause the splitting up of the bodies themselves. The disruptive action requisite to separate a mass from the principal body entirely, and so as not to return, would be less as the mass of the body is smaller, and would, for a mass no larger than some of the asteroids, be quite within the range of possibility. The body would thus be subject to a continuous process of disintegration in its successive revolutions, and must end in being broken up into a swarm of fragments which would gradually be distributed over the entire orbit. Such an action appears to be really going on in some of the comets, and moreover the orbits of several of them are coincident with those of great meteoric streams, in which the process of disaggregation has already gone very far. Now, of the comets of short period a considerable number are grouped with their orbits in such a relation to that of Jupiter as to suggest the possibility of their derivation from the asteroids. Similar considerations also apply to the group of comets associated with the orbit of Neptune, the existence of which suggests the question whether there may not be another group of asteroids, exterior to this body, yet remaining to be discovered. But without assuming the asteroidal origin of these comets, the effects of solar heat just described may be safely predicated of them, as well as of other comets or meteoric masses revolving in excentric orbits.

This process of disintegration, in the earlier stages of the history of one of these bodies, would constantly present fresh surfaces for the action of the sun's rays, which must cause the evolution of large volumes of gas, and the rifts and fissures produced by the cooling at aphelion would allow the gas contained in the interior of the body to stream off under comparatively little increase of temperature. This gaseous matter, expanding into empty space and streaming off, forms the tail of the comet, which is driven away from the sun's direction by some repellent force possibly due to electrical action. That the amount of gaseous substance furnished by such a body should be sufficient to form a luminous train of the immense extent often observed in comets need not appear incredible, if we reflect that of a substance like the Kold Bokkeveld meteorite every cubic mile would furnish 30 cubic miles of gas at the pressure of the terrestrial atmosphere, and that this in space would be speedily expanded to enormous dimensions, before it would cease to be capable of transmitting electric discharges, or to be visible by reflected sunlight. As the masses of some of the comets have approached planetary dimensions there is no difficulty in accounting for the enormous trains some of them have exhibited. Moreover, there is reason for believing that the meteorites which reach the earth are the spent fragments, as it were, which have already parted with a considerable portion of their gaseous constituents by the long-continued action of the sun as above described, so that the amount of gas contained in some of these celestial bodies may be even much larger than that we observe in actual meteorites. We may also take into account the not inconsiderable amount of water contained in these bodies, to say nothing of the volatile carbonaceous matters which are present in some of them.

Besides the relations mentioned above may be cited the near correspondence of the average density of the stony meteorites with the calculated density of the asteroids, which, though possibly accidental, is certainly suggestive of a community or similarity of origin.

Additional and most striking testimony to the real connection of the meteorites and comets is afforded by the close resemblance of the spectrum of the gas obtained from the stony meteorites to the spectra of those comets which have thus far been observed.

Many observations respecting this point were made upon the gases collected from the various meteorites examined in the course of the investigations which have been described. Vacuum-tubes, of the form usually employed in spectroscopic work, were attached to the pump and filled by the meteoritic gases as they were evolved. After the latter had been pumped out for the most part into the collecting-tube, a freezing mixture was applied to one of the tubes of the pump and allowed to remain until the watery vapour was condensed, thus rendering the gas in the vacuum-tube very nearly free from moisture. As the vapour of mercury is always shown by spectroscopic examination to be present in tubes filled in this way by the use of a mercury-pump, small pellets of clean gold-foil were previously placed in the tubes, in order to absorb the metal. This proved to be quite effectual in some cases, in others only partially so. The tubes, having now been sufficiently exhausted by the continued action of the pump, were removed, sealed, marked, and preserved for examination.

On passing the discharge of an induction-coil through these tubes when placed before the slit of a spectroscope, a spectrum is seen, which varies with the conditions. That from the capillary portion of the tube shows the hydrogen lines brilliantly, together with the bands due to carbon compounds. In the wide part, however, the hydrogen lines are entirely absent, only the carbon bands being visible. When the illumination is sufficiently strong these are five in number, all sharp at the least refrangible edge, and fading gradually away at the other. When the slit is narrowed, or the tube removed to a greater distance so as to diminish the intensity or the light, only three remain visible, namely, one beginning in the yellowish green, one in the green, and another in the greenish blue. Of these the middle one is by far the brightest, and when the light is very much enfeebled remains visible after the others have disappeared. Of the latter, the one in the greenish blue is brighter than the other. A resemblance to the spectra of the comets is apparent at a glance, not only in the positions, but also in the form and relative brightness of the bands. A closer comparison, however, shows a marked difference in their breadth, the cometary bands, as represented by various observers, covering a considerably greater space. There appeared also to be a want of exact coincidence in their positions. For the first two the difference was not greater than the discrepancies of the results given for different comets, and the bands agreed very well with some of the observations. The third band showed a greater divergence.

As the greater breadth of the cometary bands indicates a density of the cometic gases greater than that in the tubes examined, an experiment was made, as follows, for the purpose of observing the effect of increasing the density of the gas. A glass tube, having an internal calibre of about 1 centimetre and some 20 centimetres in length, was closed at one end, and through the sides were inserted two platinum wires, at points near the middle of the tube, the inner ends of the wires being in its axis and separated

by an interval of about 1 centimetre. Small fragments of the Kold Bokkeveld meteorite were dropped into the tube and shaken down into the closed end. The upper end was now drawn out to a narrow neck, and the whole attached to the pump. After exhausting the air, the neck was sealed, the tube withdrawn, and supported in a vertical position so that the interval between the wires was before the slit of the spectroscope, the end containing the meteorite being below. By means of wires connecting the platinum points with an induction-coil, sparks were passed across the interval, and when the lower end of the tube was gently heated the characteristic spectrum of the gas evolved became visible. At first it was very similar to that which had been observed previously, but as the heat was increased, and the pressure of the gas became greater, the bands were seen to widen out, until they at length fully equalled in breadth those of the comets, and finally they showed a tendency to run together. In the order of their relative intensity there was no appreciable change.

The slight disagreement in the positions of the first two bands with the reported observations of cometary spectra is readily explained when we consider that for the latter a rather wide slit is necessary in order that they may be distinctly seen. If the object viewed were a sharp fine line, the effect of opening the slit would be merely to increase its breadth without affecting the sharpness of the edges. It is easy to see, however, that a band, though with a narrow slit the edge were sharp and brighter than the other parts, would have its point of maximum brightness removed toward the middle of its breadth, and the farther as the opening were greater. The effect of this would be that a faint band would appear hazy at the edge, and the tendency would be to displace its apparent position towards the brightest point. Further, the measured position of the edge would be affected by the change of place of the movable edge of the slit. A simple experiment with the tube showed that the alterations from these two sources were sufficient to account for the apparent want of agreement in the positions of the bands, and also to explain some of the discrepancies in the results of different observers, as to the position of the cometary bands, especially when regard is paid to the faintness of the light and the consequent difficulty of precise determination. Measurements of the first two bands, with the slit rather wide and the intensity of the light sufficiently diminished, were found to coincide very satisfactorily with the best recorded observations upon the corresponding bands in the spectra of comets. For the third band the result was less satisfactory, as it appears to be somewhat less refrangible than its cometary analogue, as determined by the majority of observations of the latter, though it agrees very well with some of them. Not improbably, however, the hydrocarbons existing in small quantities in some of the meteorites may be present in the comets in sufficient amount to modify their spectra somewhat.—*American Journal of Science and Arts.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 15th, 1877.

Dr. J. H. Gilbert, F.R.S., Vice-President, in the Chair.

The names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, the names of Messrs. A. Angell, F. W. Young, E. W. Napper, and H. G. Stacey were read for the first time. Messrs. Michael Conroy, Arthur Pearson Luff, John Angell, Joshua Bardsley, Matthew Algernon Adams, and Peter Townsend Austen were ballotted for and duly elected, after their names had been read the third time.

The Chairman, in accordance with the bye-laws, announced the proposed changes in the Council and Officers of the Society for the ensuing year. It is proposed to elect Dr. J. H. Gladstone as President in place of Professor Abel, who retires. The Vice-Presidents are Mr. Field and Dr. Roscoe in place of Mr. Longstaff and Dr. Gladstone. The other members of Council are Messrs. I. Lowthian Bell, C. E. Groves, W. N. Hartley, T. Hyde Hills, and G. Matthey in place of Messrs. D. Campbell, J. Dewar, F. Field, N. Story Maskelyne, and W. Valentin.

The first paper was by Dr. A. Dupré, "*On the Estimation of Urea by means of Hypobromite*," the object of the communication being to describe a form of apparatus which could be conveniently worked, and such modifications in the preparation of the hypobromite solution as to prevent the escape of any bromine vapour, so that the process might be used in the wards of an hospital. The apparatus consists of a burette inverted in a tall cylinder of water, and connected by a side tube with the generator by means of a long piece of caoutchouc tube. The generator containing the proper quantity of hypobromite is a bottle closed by a vulcanised cork, through which passes a short tube to connect it with the burette, and also having a small test-tube attached to it to contain 5 c.c. of the urine under examination. After the cork has been firmly inserted the urine is mixed with the hypobromite by gently inclining the generator. The latter is briskly agitated for a short time, and then plunged into cold water. After allowing the apparatus to stand a few minutes to cool the gas to the same temperature as the water, the level of the liquid inside and outside the burette is made the same by raising the latter, and the reading of the gas taken and also that of the thermometer. The necessary quantity of hypobromite is easily prepared by pouring into a stoppered cylinder enough caustic soda solution (100 grains to 250 c.c. of water) to fill it up to a 25 c.c. mark on the side, introducing a thin sealed tube containing 2·2 c.c. of bromine, and agitating briskly so as to break the thin tube. The amount of nitrogen given off is found to be 91 per cent of the total quantity in the urea, and the burette may be so graduated that it gives readings of the percentage of urea at the normal pressure and temperature.

The Chairman said they were much indebted to the author for facilitating the process for the estimation of urea, one of the most important in hospital practice, as showing the amount of nitrogen eliminated by the renal organs. Although urea represents nearly all the nitrogen in the urine of the human subject, this was not the case with the ruminants.

Dr. C. R. A. Wright remarked that in some experiments on this method of determining urea, made in his laboratory by Dr. Blackley, a slightly higher percentage of nitrogen had been obtained, about 93 per cent. The apparatus described by Dr. Dupré possessed considerable advantages over those of Russell and West and of Dr. Blackley, as there was no danger of spilling the corrosive hypobromite solution if ordinary care were taken: at the same time, in agitating the generator, the latter might get heated, and thus increase the reading.

Prof. Hartley suggested the substitution of a gutta-percha tube for holding the urine in the generator in place of the fragile glass one.

The next communication was on "*A New Carbometer for the Estimation of Carbonic Anhydride*," by Mr. S. T. Pruen and Dr. G. Jones. It is somewhat similar to Scheibler's "calcimeter," consisting of two equal graduated glass tubes filled with water, on the surface of which a layer of oil floats, and connected with each other by a piece of caoutchouc tubing. One of these is raised or lowered automatically, the other is fixed, and connected at its upper extremity with the generator by means of india-rubber tubing, a chloride of calcium tube being interposed between the generator and the measuring tube. The generator consists of a small flask, in which a weighed quantity of the carbonate under examination is placed,

together with a small gutta-percha tube containing hydrochloric acid. The decomposition is effected in the usual way, and the evolved gas measured, the barometric pressure being taken, and the temperature observed by means of a thermometer in the measuring-tube. Tables of data for the necessary corrections accompany the paper. The authors state that it is more convenient than Scheibler's apparatus, as it is less cumbersome, the tubes do not require refilling or emptying, and it is self acting.

Mr. Warington observed that there was a source of error in the Scheibler instrument which also attached to this apparatus, namely, that the correction to be applied for the carbonic anhydride dissolved by the hydrochloric acid was the same whatever the percentage of carbonic anhydride, whereas if there was much air and comparatively little carbonic anhydride in the flask at the close of the experiment the hydrochloric acid would absorb but little of the carbonic anhydride, whilst if the air were rich in carbonic anhydride the acid would absorb more of the latter.

Dr. Dupré called attention to the fact that although the gas was dried by passing over the calcic chloride it must become wet by contact with the moist sides of the measuring-tube, to which

Dr. Jones replied that it was found practically that the film of oil prevented the gas from coming in contact with the water, and thus becoming moist.

The next paper was "*On the Influence Exerted by Ammonium Sulphide in Preventing the Action of Various Solutions on Copper*," by Messrs. F. W. Shaw and T. Carnelly. Clean pieces of copper-foil of known surface were coated with a thin film of sulphide by immersion in dilute ammonium sulphide, and subsequently thoroughly washed. The results of the action of distilled water, and of various solutions on these as compared with similar pieces of clean copper, are given in a series of tables, from which it appears that the film of sulphide does not lessen the action of distilled water, but, on the contrary, increases it, both at the ordinary and at elevated temperatures: this is due to the oxidising action of the air, as shown by the results obtained in closed flasks completely filled with water that had previously been well boiled. In the case of saline solutions the film of sulphide lessens the action on the metal; the salts experimented with being potassic nitrate, sulphate, and carbonate; sodic chloride, nitrate, and carbonate; magnesic sulphate; and ammonic chloride, nitrate, and sulphate.

The Chairman having thanked the author,

The Secretary read "*An Experimental Enquiry as to the Changes which occur in the Composition of Waters from Wells Near the Sea*," by Mr. W. H. Watson. The well examined was about 9 feet deep, the bottom being 24 feet above the level of the sea, and was situated at Brystones, near Whitehaven, about half a mile distant from the sea. Determinations of the chlorine were made each day, the water being collected at about 10 a.m., and the results are given in a table. The amount of chlorine varied from 5·95 to 17·50 grains per gallon, whilst the other constituents, such as sulphates, remained almost constant. The author considers the variation observed in the water of this well, situated in an alluvial soil, to be due chiefly, but not entirely, to the weather, as from the nature of the intervening strata it may be directly subject to infiltration of sea-water.

Mr. F. Maxwell Lyte said that he had examined the mineral water at the Source de Salut, Bagnères de Bigorre during many years, and had found that from October to December an extraordinary change took place in the nature of the water, as it became sulphureous, and the quantity of salt in it increased. It was probable that the deep spring was sulphureous, but became altered by the infiltration of other springs near the surface, which after the droughts of summer partially dried up: thus the supply of oxygen being partially cut off the spring resumed its sulphureous character.

Mr. C. E. Groves remarked that springs in alluvia soils near the sea might derive much of their chlorine from the scud driven over the land in stormy weather, and which, settling on the land, was washed in along with the surface-water by subsequent rains.

The Chairman, in thanking the author, said it was necessary to know all the circumstances connected with the well before the source of the large amount of chlorides in it could be definitely accounted for.

"*On the Solvent Action of Various Saline Solutions on Lead*," by Mr. M. M. P. Muir. The author, from an examination of the action of various saline solutions on lead, infers that in the first place a soluble salt of lead is produced, which by the action of carbon dioxide absorbed from the atmosphere is slowly converted into hydrocarbonate, in which form it is, to a greater or less degree, precipitated. In certain solutions, especially those containing ammonium nitrate and calcium chloride, the formation of the soluble lead salt proceeds more rapidly than its precipitation as hydrocarbonate, although after long periods the latter action preponderates. Lastly, carbonates reprecipitate the soluble lead salt in the form of hydrocarbonate as fast as it is produced. A table showing the solubility of lead hydrocarbonate in the saline solutions examined is appended to the paper.

The Chairman having thanked the author,

Two other papers were read by the Secretary, the first being a preliminary notice on "*The Derivatives of Di-Isobutyl*," by Mr. W. Carleton-Williams. The di-isobutyl employed in the investigation was prepared by the action of sodium on isobutyl bromide, and boiled at 109° C. Submitted to the action of chlorine it yielded a liquid possessing an odour resembling that of the orange, and consisting of a mixture of iso-primary and iso-secondary octylic chlorides boiling at 170° to 180°. The mixed chlorides heated with potassic acetate and acetic acid at 200°, yielded, besides the octylic acetates, an octylene boiling at 122°, and which had a specific gravity of 0·7526 at 16°. The mixed acetates boiled at 193° to 205°, and by treatment with potassic hydrate were converted into a mixture of the primary and secondary octylic alcohols boiling at 175° to 187°, the quantity of which was too small to permit of any attempt at separation. It was therefore oxidised by potassium dichromate and sulphuric acid, when it yielded iso-caprylic acid and an aceton, which on further oxidation split up into acetic and carbonic acids. From these results it would seem that the secondary alcohol is isopropyl-isobutyl-carbinol,—

$$CH(CH_3)_2.CH(OH).CH_2.C(CH_3)_2,$$

whilst the primary alcohol may be represented by the formula—

$$CH(CH_3)_2.CH_2.CH_2.CH(CH_3).CH_2(OH)$$

The isocaprylic acid is an oily liquid, somewhat resembling valerianic acid in odour. Its silver salt is slightly soluble in boiling water, and is deposited on cooling in minute tooth-shaped crystals. The barium lead and zinc salts are amorphous, but the calcium salt is characteristic, crystallising in plates radiating from a central point. It is less soluble in hot than in cold water, so that on raising the temperature of a solution saturated at 15° to 36° C. the salt is precipitated.

"*Notes on Madder Colouring Matters*," by Dr. E. Schunck and Dr. H. Rœmer. The first of these describes a method of detecting small quantities of alizarin in mixtures of alizarin and purpurin by exposing the solution of the substance in caustic alkali to the air until it has become almost colourless: the purpurin is thus decomposed, and on agitating the acidified solution with ether the alizarin is taken up, and may be recognised in the usual manner by its absorption-spectrum. The second note is on "*Purpuroxanthic Acid, a Colouring Matter Found in Commercial Purpurin*," from which it was separated by boiling it with alum liquor, precipitating by hydrochloric acid, and extracting the precipitate with alcohol. A residue containing alumina was left, which gave purpuroxanthic acid by crystallisation from alcohol mixed with a

little hydrochloric acid. This acid may also be obtained from the alcoholic mother-liquors obtained in crystallising commercial purpurin, by evaporating them, boiling the residue with water, and adding hydrochloric acid to the filtrate, which throws down the impure purpuroxanthic acid as an orange precipitate. It is purified by boiling it with baryta, which dissolves the impurities, and leaves the acid as a baric salt. Purpuroxanthic acid, $C_{15}H_8O_6$ or $C_{14}H_7O_4.COOH$, crystallises in yellow lustrous needles or scales, which are easily soluble in alcohol or acetic acid, and far more so in boiling water than most madder products. It melts at 231°, and at 232° to 233° C. decomposes, giving off carbonic anhydride, and leaving purpuroxanthin, $C_{14}H_8O_4$, no other substance being produced. Purpuro-xanthic acid dyes alumina and iron mordants orange and brown respectively, but the colours are very fugitive.

The CHAIRMAN having thanked the authors, adjourned the meeting until Thursday, March 1, when there will be a lecture by Professor T. E. Thorpe, "On the Theory of the Bunsen Lamp."

PHYSICAL SOCIETY.

February 17th, 1877.

Professor W. G. ADAMS, Vice-President, in the Chair.

MR. T. W. PHILIPS, C.E., was elected a Member of the Society.

Prof. GUTHRIE exhibited for Mr. C. J. Woodward an apparatus he has devised for showing to an audience the interference of transverse waves. A light frame, capable of moving in a vertical plane, carries a horizontal strip of tin about 2 feet in length, cut in the form of the ordinary sine wave, and which supports by means of a pulley a light wooden block carrying an ink recorder in front of a sheet of paper. This block slides in a vertical slot in a piece of wood, which can be moved horizontally, supported by a roller on another similar strip of tin fixed parallel to the first, and vertically below it. The movable frame rests on a castor attached to this block. If the relative positions of the waves be now varied, and the blocks moved along them, the path traced by the ink recorder will represent the wave due to their combination.

Mr. S. P. THOMPSON exhibited some galvanometers in the form of magic-lantern slides which he has arranged for exhibiting their indications to an audience. The instruments are, however, only capable of indicating comparatively powerful currents, and he hopes to succeed in arranging forms of greater sensitiveness. The index-needle is usually formed of cardboard, and two small steel needles are attached to it parallel to its axis. It is pivoted lightly between glass plates, and influenced by the current traversing coils of wire placed beyond the circle in which it rotates. The best effects were obtained by means of two curved electro-magnets surrounding a small steel magnet, but this form is inapplicable to quantitative determinations on account of the residual magnetism of the iron cores. A gold-leaf electroscope formed on this principle was capable of detecting very small charges of statical electricity.

Mr. WILSON then showed an arrangement for exhibiting convection currents in heated water. It consists of a small glass cell with parallel sides. In the base of the wood dividing the sides is cut a slight depression to expose a brass tube which traverses it horizontally, and is open at one end, while the other is bent at right angles, and connected with a flask containing water. The brass tube, where it is exposed in the cell, is surrounded with a jelly formed of gelatine containing rosanilin, and the cell is filled with water, and projected on the screen. When the tube is heated by boiling the water in the flask, the jelly is liquefied, and the liberated colouring matter rises in the water, showing the direction of the heated current.

Prof. GUTHRIE exhibited an arrangement he has been using with a view to determine the vapour-tension of water, and explained the difficulties to which such a determination is liable, and the manner in which his apparatus has so far failed. It was shown that a crystal of alum, or a saturated solution of salt, when introduced into the Torricellian vacuum, depresses the mercurial column less than pure water, whereas solutions of size, gum-arabic, or any colloid, depress it to precisely the same extent. It thus appears that water in its different states of combination has different vapour-densities, and their determination requires an arrangement in which the several substances can be easily introduced into the Torricellian vacuum, and very slight changes of the level of the mercurial column can be ascertained. Prof. Guthrie has been employing a U-tube 33 inches long, one extremity of which is bent, and terminates in a capillary opening, and a bulb is formed at the U-bend. If the substance under examination be introduced at the open after the apparatus has been filled with mercury, inverted, and the superfluous metal escaped, the mercury expelled through the capillary opening will give a measure of the amount of depression.

Prof. MCLEOD suggested a modification of this form of apparatus.

Prof. GUTHRIE then showed the manner in which electricity is distributed on non-conductors, such as the plate of an electrophorus, by placing it for a given time beneath a point connected with a charged Leyden jar, and subsequently sprinkling a mixture of sulphur and litharge over it. It was shown that the diameter of the circle formed below the point after the superfluous powder had been removed was not purely a function of the distance between the point and the plate, but is mainly influenced by the conductivity of the material, and, further, that if the point be directed obliquely towards the plate, the circle formed is very slightly elliptical, but the ellipticity is in no degree proportionate to the obliquity of the point; and, finally, he showed that if the non-conducting plate of an electrophorus be written upon with a metal, and sprinkled with the above mixture of sulphur and litharge, the former or latter adheres according to the nature of the metal used, and he suggested that some such arrangement might be employed as a kind of electrical touchstone for discriminating between certain metals.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

February 12th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

F. TIEMANN and H. HERZFELD stated that they had obtained coumarin directly from the acetyl compound of ortho-coumaric acid by heating it to a temperature of 150°:—

$$C_9H_7O_3.C_2H_3O_2 = C_9H_6O_2 + C_2H_4O_2.$$

The melting-point of the ortho-coumaric acid lately obtained by them from salicylic aldehyd was found to rise by repeated crystallisations until it coincided with that of the acid obtained by Perkin, 207°. This varies but 1° from that of the para-coumaric acid lately prepared by them, and the two acids possess the same general appearance and solvent properties: they are, however, sharply distinguished from each other by the fluorescent properties of the potassic solution of ortho-coumaric acid not possessed by the para acid, and by the widely divergent character of the hydro-acids yielded by treatment with sodium amalgam.

A. FRANCK devoted a few words to the memory of the lately deceased chemist, S. Lindemann, of Stassfurt.

C. A. MARTIUS gave a detailed account of the petroleum industry of America.

The following communications have been received from non-resident members:—

A. WÜLLNER, in response to a late communication of F. Müller, defends the theory that the temperature of the aqueous vapour escaping from boiling solutions of salts lies above 100°.

C. HENSGEN describes the results of the "*Action of Dry, Gaseous, Hydrochloric Acid upon Magnesium Sulphate.*"

J. JOUST gives a detailed account of "*The Crystalline Components of the Bark of the Coto Tree of Bolivia.*" A number of these have been separated and analysed: they are mostly homologous to the chief ingredient, paracotoin, $C_{19}H_{12}O_6$. This body crystallises in yellow laminæ, is not easily soluble in ordinary solvents, and by treatment with BaO is changed into para-cotoinic acid, $C_{19}H_{14}O_7$. Alkalies change it into para-coumarhydrin under separation of carbonic acid:—

$$C_{19}H_{12}O_6 + 2H_2O = CO_2 + 2C_9H_8O_3.$$

S. SYLVESTRI has discovered the presenee of "*Paraffin in Lava Blocks.*" The quantities enclosed were sufficient to enable him to separate out and identify several hydrocarbons.

M. CONRAD and W. R. HODGKINSON, by the "*Action of Sodium upon Acetate of Benzyl,*" have obtained the benzylic ether of an hydro-cinnamic acid,—

$$C_6H_5.CH_2.CH_2.COO.CH_2.C_6H_5.$$

G. SCHULTZ has examined the products resulting from the "*Decomposition of Oil of Turpentine at a High Temperature.*" The decomposition was effected in an iron tube heated to a dull red-heat, and from the black tar which resulted the following hydrocarbons were separated out:—Benzene, toluen, xylen (principally 1:3), unchanged oil of turpentine, naphthalin, phenanthren, anthracen, and methyl-anthracen.

R. DYCKERHOFF, "*On Derivatives of Monochlor-acetophenon.*" By treatment with KSCN he has obtained the sulpho-cyanic ether, $C_6H_5.COCH_2S.CN$, but is unable to isolate the mercaptan, $C_6H_5.COCH_2SH$. Acetophenon gives with phosphorus pentachloride, a mono-chloro styrol.

W. BÖRNEMANN has found, in experiments "*On the Formation of the Chlorides of Iodine,*" that ClI is soluble in dilute HCl, without causing a separation of iodine. If chlorine is led into water containing iodine until the latter disappears, a slight separation of iodic acid occurs only when the solution is very concentrated. If it is attempted to change all of the iodine present into iodic acid, the solution must be at least so dilute as to contain water and iodine in the proportion of 1:10. If chlorine is conducted into a concentrated solution as long as it is absorbed, IO_3H and ICl_3 are precipitated.

W. KÖNIGS has obtained the "*Ethyl-Ether of Amidophthalic Acid,*" $C_6H_3(NH_2)(COOC_2H_5)_2$, by reduction of the ethyl-ether of nitro-phthalic acid with zinc and hydrochloric acid, at a low temperature.

V. MEYER, J. BARBIERI, and F. FORSTER have made a careful study of the "*Products resulting from the Action of Nitrous Acid upon Normal Butylamin,*" and ascertained that the statement of Linnemann and Zotta, with regard to the formation of primary isobutyl alcohol by this reaction, is an error. A part of the amine is changed into normal butyl alcohol; the greater portion is decomposed into water, nitrogen, and butylen. Of this butylen, part escapes as gas, and part unites with water to form secondary butyl alcohol. No trace of isobutyl alcohol could be observed.

C. KIMICH, "*On Derivatives of Methazonic Acid.*" The sodium salt of this lately discovered acid—obtained by treatment of nitro-methane with an alcoholic solution of caustic soda—yields, with diazo-benzene nitrate, azophenyl-methazonic acid,—

$$C_2H_3NaN_2O_3 + C_6H_5N_2NO_3 = \\ = NaNO_3 + C_6H_5N_2C_2H_3N_2O_3.$$

The formation is analogous to that of azo-nitro-methylphenyl, and the salts are, like those of the latter, always basic and rich in water of crystallisation. Azo-p aratolyl-methazonic acid is prepared in a similar manner. These two bodies are the first well-defined crystalline derivatives obtained from methazonic acid, and their analyses confirm the formula for it, $C_2H_4N_2O_3$. Reduction of the acid with sodium amalgam yields only ammonia and an amorphous mass.

G. VORTMANN, "*On Ammoniacal Cobalt-Bases.*" The author has obtained a new roseo-cobaltic chloride, $Co_2Cl_6.10NH_3.2H_2O$, by the addition of concentrated hydrochloric acid to a solution of ammonium-cobaltous carbonate, which had been oxidised by the action of the air. The new salt differs from the ordinary roseo-compound in possessing a deep carmine colour, and in yielding with dilute hydrochloric acid a new purpureo-cobaltic chloride, of a pure violet colour, and isomeric with the purpureo-compound already known.

F. VON LEPEL, "*Spectroscopic Detection of Magnesium.*" The author gives the results of a number of experiments on the practicability and sensitiveness of the spectroscopic tests for magnesium with purpurin solutions. The operations required are few in number and the results satisfactory. The presence of large amounts of lime-salts obscures the spectrum, and they must be removed with tartrate of potassium. Magnesium was found in the crystalline substance of the eye, in curds, in the juice of apples and pears, &c., and seems to be most extensively spread in the animal and vegetable kingdoms.

R. SCHIFF, "*On the Constitution of Aldehyd Ammonia and Chloral Ammonia.*" In order to prove whether a hydroxyl group is present in these compounds, chloral ammonia has been submitted to the action of acetyl chloride and acetic anhydride. In both cases a monoacetyl-chloral ammonia is obtained, perfectly identical with the chloral-acetamid obtained from the union of chloral and acetamid. If this compound is treated with acetyl chloride at a high temperature, another acetyl group is introduced, and it is evident that this last group is substituted in a hydroxyl group, on account of the easy decomposition with warm water, &c. These two reactions would lead to the structural formula of—

$$Cl_3.C(OH)(NH_2)H$$

for aldehyd ammonia. The author has found that chloral ammonia can easily be prepared in large quantities by leading gaseous ammonia through a solution of chloral in chloroform, until the latter solidifies to a compact white mass.

E. SCHUNCK and H. RŒMER, "*On Purpuroxanthin-Carbonic Acid.*" This substance, $C_{14}H_7COOHO_4$, was found in commercial purpurin. It is separated from purpurin, alizarin, and purpuroxanthin by means of its greater solubility in boiling water, and the slowness with which its alumina compound is decomposed by hydrochloric acid. It is precipitated from the aqueous solution by hydrochloric acid as a voluminous orange-coloured mass. The new acid melts at 231°, and is decomposed at 233° into carbonic acid and purpuroxanthin, from which property it receives its name. No characteristic absorption bands are given by the various solutions.

"*On the Detection of Small Quantities of Alizarin in Purpurin.*" Hitherto this was almost impossible, because the comparatively greater intensity of the absorption phenomena of alkaline purpurin solutions prevented the use of the spectroscope, and the methods of separation are at present too inexact to be applicable for small quantities. The authors find that by exposing a solution of the two substances in caustic soda to the action of the air, the liquid gradually becomes colourless, the purpurin is completely decomposed, and the alizarin—after being released from its sodic compound with HCl—can be dissolved in ether and identified by the spectroscopic reactions. A solution containing 0·00005 grm. alizarin responded to the test.

J. PICCARD, "*On Chrysin, Tecto-chrysin, and Higher Homologues.*" By the action of ethyl iodide in an alcoholic solution of caustic potash upon chrysin, the group CH_3 was introduced into the latter, thus artificially preparing the tecto-chrysin, which accompanies it in poplar buds. Ethyl-chrysin and amyl-chrysin are obtained in analogous ways. The analysis of these compounds show the formula of chrysin to be $C_{15}H_9O_3.OH$.

"*Lecture Experiment upon the Synthesis of Water.*" "*Resorcin-trisulphonic Acid,*" The author has obtained this acid, $C_6H(OH)_2(SO_3H)_3$, by the action of fuming sulphuric acid upon resorcin-disulphonic acid, in sealed tubes at 200°. It is separated in the form of the calcium salt, as the barium salt is nearly as insoluble as $BaSO_4$. The acid itself, obtained from the lead salt with H_2S, is too soluble to be crystallised.

E. SCHMIDT, "*On the Formation of Allyl-iso-sulphocyanate.*" Potassium myronate, treated at 0° with a myrosin solution (filtered extract of white mustard), yields allyl-iso-sulpho-cyanate, with small quantities of the isomeric sulpho-cyanate."

"*On Camphor of Cubebs.*" The author's opinion that this is a hydrate of oil of cubebs is strengthened by its decomposition into water and oil of cubebs at ordinary temperature, when left for some time over sulphuric acid.

"*Action of Carbonyl Sulphide upon an Aqueous Solution of Ammonia.*" As in the case of an alcoholic solution of ammonia, ammonium oxy-sulpho-carbamate is formed.—

$$COS + 2NH_3 = H_2N\ CO - SNH_4.$$

This suffers gradually the two following decompositions :—

$$COSN_2H_6 = CO(NH_2)_2 + H_2S,$$
$$COSN_2H_6 + H_2O = CO_2 + NH_3 + H_2S.$$

If treated with freshly-prepared hydrate of lead, or carbonate of lead in the cold, the first decomposition is the principal one, and the liquid yields, upon filtration and evaporation, considerable quantities of urea. On account of its ease and rapidity this method of preparing urea is adapted for lecture experiments and the production of small quantities.

"*On the Compounds of Morphine with Hydriodic and Hydrobromic Acids.*" The author finds that the two compounds obtained, one by the action of KI upon morphine acetate, and the other by solution of morphine in HI, hitherto regarded as two different bodies, are in all respects identical. The bromine compound obtained from the solution of morphine in HBr posseses the formula—

$$C_{17}H_{19}NO_3BrII + 2H_2O,$$

and is in its properties analogous to the iodine compound. The same author has found the specific gravity of bromoform at 14·5° to be 2·775.

A. KERN finds, in the course of experiments "*On the Preparation of Mono-Methyl Aniline,*" that aniline and methyl iodide do not yield this body, as stated in most text-books, the reaction being as follows :—

$$3(C_6H_5.NH_2) + 2CH_3I =$$
$$= C_6H_5.N(CH_3)_2 + 2(C_6H_5.NH_2.HI).$$

E. SCHULZE and J. BARBIERI have found "*Glutamine,*" $C_5H_8NO_3NH_2$, in the young sprouts of gourds, forming 1·75 per cent of the dried substance. It is formed during germination, and appears to perform the same part as asparagin in other germs, viz., providing albumen for the wants of the growing plant.

RUSSIAN CHEMICAL SOCIETY.

N. SOKOLOFFSKY, "*Action of Bromine upon Aceton.*" By the addition of bromine to an aqueous solution of aceton the author forms two liquid substitution-products, mono-brom-aceton and dibrom-aceton. The first has the sp. gr. 1·99, is colourless, possesses strong refractive powers, and a strong penetrating odour attacks the eyes violently, and cannot be distilled alone without decomposition, but is easily carried over with aqueous vapour. Dry ammoniacal gas forms with it an unstable crystalline compound, analogous in composition to aldehyd ammonia. Aqueous ammonia yields several soluble bases. Iodine and ammonia change it into iodoform and acetic acid. Dibrom-aceton has the sp. gr. 2·55 and is less unpleasant. Both bodies yield with acid sodium sulphite characteristic crystalline compounds. The addition compound $C_3H_6OBr_2$ was obtained by the addition of bromine to an aqueous solution of aceton kept constantly at a low temperature. It explodes as soon as freed from the water.

S. PRZIBTEK, "*Synthesis of a Oxybutyric Acid.*" This acid, $CH_3.CH_2.CH.OH.COOH$, is prepared synthetically by the action of hydrocyanic acid and hydrochloric acid upon propyl aldehyd; thus confirming the structural formula of the acid already proposed by Markownikoff.

G. LAWRINOWITSCH, "*On the Pinacon and Pinacolin Derived from Methyl-ethyl-keton.*" See CHEMICAL NEWS, vol. xxxv., p. 53.

J. KANNONIKOFF and A. SAYTZEFF, "*Action of Allyl-iodide and Ethyl-iodide upon Ethyl-formiate.*" These three compounds mixed together and headed with zinc, yield diallyl carbinol.

D. BOBYLEN, "*Theoretical Researches Regarding the Distribution of Static Electricity upon the Surfaces of Conductors Composed of Heterogenous Parts.*"

O. CHWOLSON, "*On Electric Rays.*"

CORRESPONDENCE.

PATENT LAW AMENDMENT.

To the Editor of the Chemical News.

SIR,—Taking an active interest in the Patent Law Amendment, I shall be glad of any practical suggestions bearing upon the proposed bill from chemists and others. May I beg that such may be sent to me as they occur, in as short a compass as may be. As I act only as a private individual I would suggest that duplicates be sent to the Inventors' Institute (of which I am not a member).

The bill proposed last session had so many shortcomings that the importance of thought and action beyond legal circles is too evident to require any demonstration.—I am, &c.,

MARSHALL HALL.

13, Old Square, Lincoln's Inn, W.C.
February 17, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 5, January 29, 1877.

Reply to Dr. Bastian.—M. L. Pasteur.

Germs of Bacteria in Suspension in the Atmosphere and in the Waters.—MM. L. Pasteur and Joubert.—A continuation of the interminable controversy on spontaneous generation.

Researches on the Irisation of Glass.—MM. E. Fremy and Clémandot.—In a former memoir on the aventurine of Venice the authors have shown that it is possible to obtain a glass comparable to that once manufactured in Italy by causing silicate of ferrous oxide to react upon silicate of copper in a vitreous mass, and at a suitable temperature. Under these conditions the silicate of iron passes to the maximum of oxidation, reducing the silicate of copper, and producing in the glass those metallic and brilliant crystals which characterise

aventurine. Glass, submitted to influences which determine its gradual decomposition, becomes covered with slender laminæ, which produce very remarkable phenomena of irisation. This alteration of glass may be witnessed either upon glasses which have remained under water or in moist ground, or upon the windows of stables exposed to ammoniacal vapours, and especially upon glass objects found in ancient burial places. M. S. Meunier has exhibited a glass iridised under the influence of the acid vapours thrown off by certain volcanic ashes. The authors have attempted to produce in a regular manner this irisation, which gives glass the aspect of pearl or of nacre, and to render it permanently adhesive. After numerous attempts they have succeeded in the most complete manner. Their process consists essentially in submitting the glass, under the influence of heat and pressure, to the action of water containing 15 per cent of hydrochloric acid. Several kinds of glass are suitable for this operation, whilst others are not adapted for it; the chemical composition and the conditions of re-heating and annealing have an influence upon this phenomenon. In the manufacture of ordinary glass, the ease with which it becomes iridescent is a defect. This is especially the case with glass intended for bottles, optical glasses, &c., the resistant power of which may be tested by submitting it to the process devised by the authors.

Report on a Memoir of M. H. Becquerel entitled "Experimental Researches on Rotatory Magnetic Polarisation."—M. Becquerel's paper may be regarded as a continuation of the researches of Faraday on the magnetisation of light.

Products Obtained by the Ignition in Closed Vessels of the Dregs of Beet-root Treacle.—M. Camille Vincent.—Among the products obtained are ammonia, trimethylamin, methylic alcohol, cyanide and sulphide of methyl, hydrocyanic, formic, acetic, propionic, butyric, valerianic, and caproic acids; carbides of iron not examined, phenic acid, a series of oily alkaloids, finally a mixture of hydrogen, protocarbide of hydrogen, carbonic acid, and carbonic oxide.

A New Arrangement of Lightning-Rods.—M. Jarriant.—The author employs hollow rods, and thus obtains an increased conducting surface with less weight.

Effects Produced by the Addition of Foreign Bodies to Carbon in the Preparation of Coke Pencils for the Electric Light.—The addition of certain salts of magnesia and lime, especially bone-earth, was found to increase the light produced, but the flame and smoke accompanying these electro-chemical lights appeared such an obstacle in the way of their utilisation that the experiments were discontinued.

Researches on the Spectra of Metals at the Base of Flames.—M. Gouy.—Reserved for insertion in full.

Preparation of the Alkaline Nitrites.—M. A. Etard.—Equal molecules of a nitrate and of the corresponding sulphide are heated to redness in a crucible. When cold the powdered mass is treated with a small quantity of alcohol, which dissolves out the pure nitrite.

Formation of Natural Sulphur Waters.—M. E. Planchud.—The author, who has experimented on one spring merely, concludes that such waters owe their sulphur to the reduction of various sulphates, effected by the agency of living beings, acting as ferments. Dead organic matter does not suffice.

Reimann's Färber Zeitung.
No. 2. 1877.

With reference to a Parisian contemporary Dr. Reimann writes—"We entirely agree with Prof. Kolbe that chemistry in Germany, instead of searching for facts, is engaged with unfruitful speculation on the position of atoms. But is the case different in France? It is well known that the so-called "new" direction, which now becomes so pernicious, took there its origin."

MEETINGS FOR THE WEEK.

MONDAY, 26th.—London Institution, 5.
— Medical, 8.
— Royal Geographical, 8.30.
TUESDAY, 27th.—Royal Institution, 3. Prof. Garrod, "On the Human Foot: its Structure in Relation to its Contour."
— Civil Engineers, 8.
— Antiquaries, Sugical Institute, 8
WEDNESDAY, 28th.—Society of Arts, 8. "Middle Class Education in Ireland," by John Yeats, L.L.D.
THURSDAY, March 1st.—Royal, 8.30.
— London Institution, 7.
— Royal Society Club, 6.30.
— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
— Chemical, 8. "Theory of the Bunsen Flame," by Prof. Thorpe. Experimentally illustrated.
FRIDAY, 2nd.—Royal Institution, 9. "History of Birds," by Prof. Huxley.
— Society of Arts, 8. (Indian Section). "The Progress of Trade in Central Asia," by Sir Douglas Forsyth, C.B., K.C.S.I.
— Geologists' Association, 8.
SATURDAY, 3rd.—Royal Institution, 3. Prof. H. Morley on "French Revolution and English Literature."
— Physical, 3.

TO CORRESPONDENTS.

ERRATUM.—In No. 865, p. 63, col. 1, line 11 from bottom, *for* "the carnation" *read* "cloves."

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London: LONGMANS and CO.

BOARD OF WORKS FOR THE POPLAR DISTRICT.

APPOINTMENT OF ANALYST.

The Board will, at their meeting to be held at the Offices, on Tuesday, the 13th day of March next, at 6 o'clock p.m., be prepared to receive Applications from duly qualified persons, according to the provisions of the "Sale of Food and Drugs Act, 1875," desirous of being appointed Analyst of this District for a period of One Year at a salary of £100, the minimum number of analyses to be made during the year to be one hundred. Candidates will have due notice when they are required to be in attendance. The Laboratory, with all appliances, has been provided and will be maintained by the Board. Applications, accompanied by not more than two testimonials, addressed to the Board of Works for the Poplar District, 117, High Street, Poplar, endorsed "Application for the Office of Analyst," will be received till 12 at noon of the said 13th day of March next.

The attention of Candidates is particularly called to the 10th Section of the Act, which provides that no person shall be appointed an Analyst of any place who shall be engaged directly or indirectly in any trade or business connected with the Sale of Food or Drugs in such place.

No expenses will be allowed to any Candidate.

WM. HENRY FARNFIELD.
Clerk to the Board.

Offices, 117, High Street, Poplar,
February 19, 1877.

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THE CHEMICAL NEWS.

Vol. XXXV. No. 901.

ON THE

SOLUBILITY OF ETHER IN AQUEOUS HYDROCHLORIC ACID.*

By HARRY NAPIER DRAPER, F.C.S., M.R.I.A.

I AM unable to find that the fact of the considerable solubility of ether in aqueous hydrochloric acid is one generally known. It is not mentioned in any of the more modern works on chemistry, and the only reference to it is, as far as I know, made by Gmelin,† who says—"It"—ether—"likewise dissolves in aqueous hydrochloric acid without producing chloride of ether,"—a statement which is referred to Boullay. The experiments which I have made in this direction will be better understood in the light of a preliminary note on the solubility of ether in other liquids. The following are the results of several independent observations:—In *saturated solution of calcium chloride* ether is apparently quite insoluble. *Distilled water* at 11° C. dissolves, in 100 volumes, 10 volumes of ether. This solubility in water is quite in accordance with results hitherto obtained, but it is customary to state the converse case—*i. e.*, the solubility of water in ether—as 1 in 10, which is much greater than it really is. As the mean result of five experiments I have found that 100 volumes of ether at 12° C. dissolve 2 volumes of water. The error has obviously arisen in the use of ether not absolutely free from alcohol.

The ether employed in my experiments was found to have at 14° C. the density of 0·725, but there is sufficient experimental difficulty in determining the weight of so volatile and expansible a fluid to prevent my attaching any considerable value to this figure. The ether was, however, shaken with finely-divided acetate of rosaniline, and, as this did not communicate the least tint to it, it was concluded that it did not contain *alcohol*. For *water* it was tested by the immersion of bibulous paper saturated with alcoholic cobalt chloride and then dried. This remained blue after twenty-four hours' contact.‡

The aqueous hydrochloric acid was the strongest that I could conveniently work with. It had a specific gravity of 1·196 at 14°, and examined volumetrically was found to contain 38·52 per cent by weight of real acid. Even at this strength it emits dense fumes when exposed to the air.

When equal volumes of the ether and hydrochloric acid just described are mixed together, immediate solution of the ether takes place, the temperature of the mixture at the same time rising considerably. There is also contraction of volume. When 50 volumes of ether and 50 volumes of acid are employed, the resulting solution, when cooled to the temperature which the liquids had before mixing, measures but 95 volumes, and at 14° C. has a specific gravity of 1·010. The solution flows like a thin oil, fumes in the air, is perfectly transparent, and remains so whether cooled to 0° or heated to 38°.

But hydrochloric acid of 38·52 per cent will dissolve much more than its own volume of anhydrous ether. In a very early stage of my experiments it became evident that the quantity which it is capable of taking up bears an inverse ratio to the temperature, and that the volume of ether dissolved is at the ordinary atmospheric pressure constant for any given temperature. The experiments were made with a closely-stoppered graduated tube, in which was added to a known volume of the acid a few volumes more ether than it was able to dissolve at the lowest temperature employed. The mixture was then cooled down to the required temperature and kept at this for an hour, during which time the tube was frequently briskly shaken, and the volume of ether dissolved was then noted. In this way were obtained the results stated in the following table, in which the second and fourth columns give the number of volumes of ether dissolved by 100 volumes of hydrochloric acid, sp. gr. 1·196, at the corresponding temperature in the first and third columns:—

Temperature Centigrade.	Vols. of Ether Dissolved.	Temperature Centigrade.	Vols. of Ether Dissolved.
−10°	185·0	16°	162·5
0°	177·5	21°	157·5
1·8	172·5	27°	150·0
9°	170·0	32°	142·5
10	167·0	38°	135·0

Thus, while at 0° C., 100 volumes of this acid dissolve 177·5 volumes ether; at 38° C. 135 volumes only are dissolved. Or by weight, 100 parts hydrochloric acid dissolve at the lower temperature 107·5 parts ether, and at the higher but 81·8 parts. So that the capacity of hydrochloric acid of this strength for ether is nearly one-third (31·4 per cent) greater at the freezing-point of water than at 38° C. (100° F.) I cannot recal an instance of so great a difference between the relation of solubility to temperature in the case of any two other fluids.

If the solution, saturated at any given temperature, be heated to a temperature higher than this, it at once becomes turbid from the separation of ether, and when the liquid is contained in a thin tube the contact of the warm hand is sufficient to produce in a few seconds complete opacity in a solution which, at the temperature of the laboratory, was quite transparent.

If a sealed tube containing the ether solution and excess of ether, first cooled (say in melting ice), then shaken, and the volume of unabsorbed ether noted, be suspended in a warm room, ether continues to separate in very minute bubbles until the liquid has attained the temperature of the surrounding air. When the tube is once more cooled to 0° without agitation, the liberated ether, being so much lighter than the solution, is not taken up again even after forty-eight hours, but on the tube being briskly shaken it is at once dissolved.

The increase of temperature at the moment of solution is considerable, being, with 10 c.c. of acid and 17 c.c. of ether, from 11° to 35° (*i. e.*, 22·5° C.).

No chemical combination takes place: the ether is simply dissolved by the acid, and can be separated by simple dilution with water. Thus 5 volumes of a solution (= 3 volumes ether) gave, on addition of 5 volumes of water, 2 volumes ether. By distillation nearly all the ether may be recovered. Two experiments were made in this direction, and in each case 17 c.c. ether were obtained from a solution which—calculating from the temperature at which it was saturated—contained 19 c.c.

The solvent power of aqueous hydrochloric acid for ether is directly proportional to the strength of the acid. Thus the acid of 38·52 per cent, which I have used in my experiments, dissolves at 10° C., in 100 volumes, 167 vols. of ether, while the acid of the British Pharmacopœia, containing 31·8 per cent HCl, dissolves at the same temperature but 125 volumes.

It should be noted that absolute ether dissolves hydrochloric acid from the aqueous acid. The acid of 38·52 per cent was agitated for some time with excess of ether, the temperature being 12° C. The supernatant ether was then removed with a pipette, and its contained chlorine determined by an alcoholic solution of silver nitrate. It was found to contain chlorine equal to 2·409 per cent of real hydrochloric acid.

* Read at the meeting of the Pharmaceutical Society of Ireland February 5, 1877.

† "Handbook," vol. viii., p. 190.

‡ Much of the "anhydrous" ether of commerce reddens cobalt paper at once, and is itself very soon tinged by the rosaniline salt.

ON RUSSIAN PLATINUM-ORE FROM THE OURAL MOUNTAINS.

By SERGIUS KERN, St. Petersburg.

Considerable quantities of platinum-ore are every year mined in Nishni-Tagil and Goroblagodatsky districts on the Oural Mountains. The platinum-ore of these districts contains notable quantities of foreign metals of the platinum group, except ruthenium, which is only in traces found in these ores. The analyses of some newly found platinum-ores near the districts mentioned above may be of some interest to chemists studying the properties of the compounds of rare metals of the platinum group, as the ore is sold at the Mint in St. Petersburg at a very moderate price.

Analyses of Platinum-Ores.

1. *Goroblagodatsky District.*
Samples.

	No. I.	No. II.	No. III.
Platinum	87·50	84·50	80·05
Rhodium	1·20	2·90	1·05
Iridium	0·05	0·90	2·50
Osmium	0·01	0·60	traces
Palladium	1·05	0·05	2·03
Iron	8·60	7·55	11·04
Copper	0·65	0·60	1·02
Osm-iridium	1·50	2·80	2·51
Total	100·56	99·90	100·20

2. *Nishni-Tagil District.*
Samples.

	No. I.	No. II.	No. III.
Platinum	80·87	71·20	89·05
Rhodium	4·44	1·50	4·60
Iridium	0·06	2·40	traces
Osmium	traces	0·05	traces
Palladium	1·30	1·95	2·35
Iron	10·82	13·40	3·40
Copper	2·30	6·70	0·59
Osm-iridium	0·11	2·65	traces
Total	99·90	99·85	99·99

Nearly all the platinum-ore obtained in Russia is sent abroad, because in this country there are no refineries of platinum-ore. A year ago a small platinum refinery commenced to work on a small scale in Petersburg, but the production of platinum articles is, as it seems to be, very limited. It is a curious fact that platinum sold abroad in a raw state at a very moderate price returns back to Russia in ready chemical articles of a very high price. Thus platinum crucibles are sold by weight at a price of 5s. 6d. for every 4 grms. of platinum; 1 drm. of platinum chloride 2s. 6d. Many Russian chemists prefer the use of French platinum crucibles, which are said to be more durable, and more cleanly prepared than English crucibles. My opinion is that English crucibles stand heat far better than any kind of crucibles. I have had in my hands for about two years several platinum crucibles brought from London, and they are all now in a workable state. The presence of copper in these crucibles was found as traces, and only in one out of five crucibles 0·002 per cent of iron was present. The following two analyses of a pair of crucibles brought from Paris shows the quality of the metal:—

No. I.

	Per cent.
Platinum	98·70
Iridium	0·56
Iron	0·30
Copper	0·22
Total	99·78

No. II.

Platinum	97·90
Iridium	1·45
Copper	0·67
Total	100·02

Of course many French works give very handsome platinum crucibles, but, on the other hand, English manufacturers send to the trade chemical apparatus prepared very carefully from pure platinum and of a very high quality, so that it is difficult to understand why in Russia English platinum crucibles are not in favour.

Obouchoff Steel Works, St. Petersburg.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 68.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

The before-mentioned plate-furnaces give in most cases very satisfatory results.

At Oker in the Harz a plate-furnace was built for hammer dust, poor in copper but rich in sulphur, such as the Rammelsberg yields in quantity. The operations carried on were changed in the meantime, and when the structure was complete it was no longer found desirable to burn the ores in the plate-furnace for which it was intended. It was charged with ores rich in copper, the burning was not satisfactory, and the furnace was removed.

Hitherto only one plate-furnace has been built behind each kiln for lump pyrites instead of arranging a system of plates above each compartment of the kiln as in Perret's furnace.

For the utilisation of the hammer dust from lump pyrites a tower suffices as given in detail in the plans published, capable of burning every twenty-four hours 600 to 1000 kilos. of ore, the granules being from 1 to 12 millimetres in diameter. Other combinations would permit a richer charge, and such will doubtless be built.

The construction described in the journal above cited (1872, p. 505) will be further considered when we treat of roasting blende. This furnace requires the maintenance of a separate fire to keep up the heat, and is only to be recommended where coal and smalls are cheap.

Experienced technologists have proposed furnaces with inclined plates, in which smalls may be burnt without the action of lump pyrites and without especial firing, as in the furnace of Maletras. Where rich pyrites are accessible such arrangements may prove advantageous, but we have no experience as to their action.

Determination of Sulphur in Pyrites.—The determination of the sulphur in the burnt ores is generally effected as follows:—The finely powdered ore is heated in a flask with a mixture of 2 parts nitric acid and 1 part hydrochloric, evaporated to dryness, and again treated with hydrochloric acid to expel any nitric acid. The sulphates are then dissolved by treating the residue with hydrochloric acid and water, filtered, and the sulphuric acid in the filtrate is determined by means of chloride of barium. Chemists have made many attempts to place a more expeditious method in the hands of the manufacturer.

In 1861, Pelouze† published a process in which the ores are treated with chlorate of potassa and a weighed quantity of pure carbonate of soda in a platinum crucible.

* "Berichte uber die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Pelouze, *Ann. Chim. Phys.*, 3, 63.

The melted mass is dissolved in water, and the excess of soda is determined volumetrically by saturation with a standard acid. Barreswill called attention to a source of error in this process in case of the presence of arsenical compounds in the ore. Bottomley and Bocheroff also pointed out its inaccuracy. J. Kolb* made some interesting comparative experiments between the determination of sulphur by the above-mentioned gravimetric process and the volumetric method of Pelouze. The results differed by several per cents. Kolb found that the source of error consisted, on the one hand, in the formation of silicate of soda, and, on the other, in the decomposition of chlorate of potassa in presence of oxide of iron into chlorine, oxygen, and caustic potassa. Kolb proposes to fuse the finely powdered ore along with 5 grms. soda and 50 grms. oxide of copper at a dull red heat; to treat the melted mass with hot water, to filter, and determine the excess of soda in the filtrate volumetrically.

In the Freiberg works† 1 grm. of finely ground ore is mixed with 3 grms. anhydrous carbonate of soda and an equal weight of saltpetre. This mixture is placed in an iron crucible melted in a muffle at a red heat, the mass is dissolved in hot water, and the liquid is filtered into a beaker, in which there is a little hydrochloric acid to saturate the excess of soda. The liquid, which should have an acid reaction is then boiled for a short time, and the sulphuric acid is determined volumetrically with a solution of chloride of barium, standardised so that 1 c.c. indicates 2 per cent of sulphur.

Utilisation of Burnt Ores.—In the French department of the Vienna Exhibition the Chemical Works of the company St. Gobain, Chauny, and Cirey, displayed iron obtained from non-cupriferous burnt pyrites. The thorough roasting of the pyrites, which makes it capable of being worked for iron, is said to have been effected by allowing the smalls to cool in thin layers, and roasting them repeatedly in Perret's furnace. The burning was effected by charging the plates alternately with burnt and with green ore. The hot gases evolved from the green smalls play over the plates charged with burnt ore and effect a second roasting.

In 1859, List pointed out the existence of zinc in the iron pyrites of the "Sicilia" mine.‡ P. W. Hofmann ascertained that this zinc is present in the burnt ore in the state of sulphate, and extracted it by systematic lixiviation.§ The solution thus obtained, sp. gr. 1·25, consists almost entirely of sulphate of zinc along with a little copperas. It is heated to about 40° and mixed with common salt in equivalent quantity. Thus there is produced a solution of sp. gr. 1·38, which, on cooling, deposits sulphate of soda in sufficient quantity to cover all expenses. The mother-liquor is concentrated to 1·60 sp. gr., and the chloride of zinc thus obtained, containing mere traces of sulphates and of iron, is sold either in the liquid or the solid form. According to P. W. Hofmann's account large quantities of zinc chloride are thus obtained at Wocklum, from the sulphur ores of the "Sicilia."

Richters‖ shows to what extent and under what circumstances the smelting of ores so rich in sulphur as are burnt pyrites in Germany could, from a chemical point of view, prove successful. In fact, many attempts have been made to utilise the burnt ores for the production of crude iron, but none of the methods proposed has found acceptance. In England the burnt Spanish, Portuguese, and some of the Norwegian pyrites are used after roasting. Wedding and Ulrich have carefully studied and described the treatment of burnt ores in England.¶

The burnt ore is sold by the chemical works to copper smelters with an average percentage of 3·66 sulphur, 58·25 iron, and 4·14 copper. It is first ground, then mixed with 15 to 20 per cent of salt, and submitted to a chlorinised roasting in reverberatories or muffle furnaces. The gases evolved are condensed in a coke tower through which water flows, thus furnishing a mixture of hydrochloric and sulphuric acid. The copper is converted by roasting into a soluble chloride, which is extracted first with water and then with the acid mixture from the condensation tower. The copper is then precipitated by iron. After nine successive lixiviations the residue contains merely from 0·08 to 0·2 per cent of copper, and 0·16 to 0·25 of sulphur, and is smelted for iron in blast-furnaces as "purple-ore." A part is also used in lining the puddling furnaces, and another small portion is reduced with coal to the state of spongy iron, and then serves to precipitate metallic copper from its solutions.

Claudet** patented a process in England for recovering the silver which is dissolved in the saline liquors as silver chloride by precipitation with iodide of potassium. His process is even applicable to ores containing merely 0·027 per cent of silver. The liquors formed by extracting the roasted ores with water contain 95 per cent of all the silver present; from these liquors the silver is precipitated to the extent of about 11·6 grms. per ton of ore. The net profit amounts to two shillings per ton of ore, giving at the Widnes copper works a yearly return of £3000.

When coal in Lancashire cost 5s. per ton, Phillips,†† after extracting the copper, precipitated the iron, and obtained fine sulphate of soda by evaporating the mother-liquor. At the present price of coal this process has been abandoned.

The chemical works of Aussig and Griesheim exhibited at Vienna large quantities of thallium. This metal is obtained from the flue dust formed on burning pyrites, deposited between the kilns and the chambers. Max Schaffner‡‡ describes the process employed at Aussig. The flue dustis repeatedly boiled in water acidulated with sulphuric acid, and from the filtered solution the metal is precipitated on the addition of hydrochloric acid as impure thallous chloride. The precipitate is washed with cold water and converted into sulphate by heating with concentrated sulphuric acid. The sulphate is then dissolved in water and again mixed with hydrochloric acid, which precipitates tolerably pure thallous chloride. This is again treated with sulphuric acid and the sulphate is reduced with pure metallic zinc. The metallic sponge thus obtained is washed with well-boiled water, dried between blotting-paper, and melted over the lamp in a porcelain crucible, into which a stream of coal-gas or of hydrogen is conducted.

To be continued.)

* J. Kolb, "Notes sur l'essai des Pyrites," 1869.
† Schwarzenberg, *opus citat.*, p. 424.
‡ List, *Tech. Chem. Mittheilungen.* Hague, 1859.
§ P. W. Hofmann, private communication.
‖ Richters, *Dingle* cxcix., 292.
¶ Wedding and Ulrich *Zeitschr. Berg. Hutten. u. Salinen w.*, xix., 292.
** Claudet, CHEM. NEWS, 1871, 134.
†† Private communication.
‡‡ Schaffner, *Sit. b. d. k. Akad. d. Wissenschaft.*, 53, Feb.; *Wagner Jahresbericht*, 1871, 1.

SCHEELE'S GREEN: ITS COMPOSITION AS USUALLY PREPARED AND SOME EXPERIMENTS UPON ARSENITE OF COPPER.§

By S. P. SHARPLES, S.B.

§ Read before the American Academy of Arts and Sciences.

IN 1778, the eminent Swedish chemist, Charles William Scheele, communicated to the Academy of Sciences at Stockholm the method of preparing the green pigment which has since borne his name. He, however, says, that it was discovered three years previously.

This pigment is of a yellowish green colour, and has been long used in the arts under various names; such as mountain green, mineral green, and Swedish green. At the time of its discovery it was the most brilliant green obtainable.

The discovery, in 1814, of the copper aceto-arsenite,

known as Schweinfurth green, Paris green, English green, and sometimes wrongly called Scheele's green, has, however, almost entirely thrown Scheele's green out of the market; and it is at the present day an unknown substance, so far as its use as a pigment is concerned; although it may be still found on the price-lists of manufacturing chemists, and the receipts for its manufacture are found in works on dyeing and calico-printing. But its covering power is very low, and it is far inferior in brilliancy to its successful rival, Paris green.

Having had occasion to examine some samples of this pigment some time ago, I became convinced that the composition of Scheele's green, as laid down in the books, was altogether a matter of conjecture, since I could find no record of any analysis that had ever been made of the substance prepared according to Scheele's directions, which have been copied without change for the last hundred years.

The formula given varies with the date; Scheele himself, of course, neither made a quantitative analysis nor gave a formula. Succeeding writers seem to have followed him in the first respect, but have given formulæ to correspond with their ideas of the composition that the salt should have.

The older writers give the formula $CuOAs_2O_3$; this would give the percentages of copper oxide and arsenic trioxide, as follows:—

Copper oxide	29·50
Arsenic trioxide	70·50
	100·00

(The atomic weights used through this paper are: oxygen, 16; copper, 63·4; the old formulæ being changed to correspond to these weights. As a matter of convenience, I have made all statements of composition in terms of copper oxide and arsenic trioxide, but in so doing I have no wish to be understood as asserting that they exist as copper oxide and arsenic trioxide in the compound.)

Berzelius* gives the formula, $Cu_2As_2O_5$; this in modern notation, would be $Cu_2As_2O_5$; or in percentages,

Copper oxide	44·50
Arsenic trioxide	55·50
	100·00

He describes the methods by which it may be obtained as either, by digesting carbonate of copper with water and arsenious acid, or by Scheele's method, giving for the latter almost exactly Scheele's receipt.

Ure† gives Scheele's receipt, and then says it consists of oxide of copper, 28·51, arsenious acid, 71·46. This corresponds to the first formula given above, $CuAs_2O_4$.

Miller‡ gives the formula $CuHAsO_3$. This in percentages would be:—

Copper oxide	42·37
Arsenic trioxide	52·83
Water	4·80

This formula seems to be the favourite one at present, and may be found in most of the text-books.

Bloxam,§ in the course of his long and elaborate investigations of the arsenites, made some experiments upon copper arsenite, but failed to obtain a definite compound. The first salt made, he says, contained:—

	Per cents.	Equivalents.
Copper oxide	40·54	1·88
Arsenic trioxide	53·80	1·00
Water	5·67	1·16

The second [illegible]

[illegible]	44·20	2·31
Arsenic trioxide	50·28	1·00
Water	5·73	1·26

The third product gave:—

	Per cents.	Equivalents.
Copper oxide	46·52	2·35
Arsenic trioxide	49·36	1·00
Water	4·12	0·62

The fourth gave:—

	Per cents.	Equivalents.
Copper oxide	42·69	1·96
Arsenic trioxide	52·67	1·00
Water	4·64	0·97

From this last analysis he deduces the formula $CuHAsO_3$. In a foot-note he says: "Scheele's prescription for the commercial green arsenite of copper involves 2·3 equivalents of oxide of copper for one equivalent of arsenious acid, so that Scheele's green dried at 212° F., appears to be essentially a mixture of $CuHAsO_3$, with an excess of oxide of copper."

This observation is perfectly correct if nothing is taken into the account except the quantities taken by Scheele; but Scheele himself says, in a foot-note:* "The water with which the colour is lixiviated contains a little arsenic, and must not be thrown out in a place to which cattle have access." The evident tendency of this loss of arsenic would be to make the salt more basic than the formula $(CuO)_{2\cdot32}As_2O_3(H_2O)_{92}$ calls for, this being the formula which Bloxam supposes to represent Scheele's green.

In Watts's "Dictionary,† under the head of arsenite of copper, this sentence occurs: "It is a light green precipitate, which dissolves in an excess of ammonia, without colour, yielding a solution of arsenic acid and cuprous oxide."

Berzelius's formula is given, and the sentence just quoted is evidently a translation, either directly or indirectly, from the same author.

The description of copper arsenite in the French edition of Berzelius, Paris, 1847, is as follows: "The neutral salt is obtained by precipitating sulphate of copper by arsenite of potassa. The precipitate is green. When it contains an excess of base, its colour is more intense; but it decomposes spontaneously, in a little time becoming a dark brown, and then contains cupric arsenate and cuprous arsenite. Caustic ammonia dissolves this salt into a colourless liquid containing, probably, cuprous arsenate." The German of 1838 is the same as the above, with the exception that it reads: "When the alkali is in excess, the colour is more intense, but it decomposes in a little time," &c. "This salt" referred to in the above paragraph, is evidently the brown salt and not the green. Moreover, the German text, and not the French, is the correct one, as is shown by my own experiments.

In this connection, the following extract is of interest. Rose says of Scheele's green: "This precipitate is soluble in an excess of ammonia, also in an excess of hydrate of potassa. The solution has in both cases a similar blue colour. The blue solution formed by hydrate of potassa deposits in time reddish brown suboxide of copper; the liquid becomes colourless, and contains arsenate of potassium. The blue solution formed by ammonia is not modified by time."

The reference from Berzelius seems to have been misunderstood by German as well as by English writers, as the same statement occurs in the *Handwörterbuch der Chemie*, B. 2, 1858, p. 300, which says Scheele's green dissolves colourless in ammonia as arsenic acid and cuprous oxide. Graham-Otto‡ also repeats the same.

In the New Chemistry,§ the above blunder is repeated, and two formulæ are given, as follows: "Arsenite of copper, $(Cu_2O)_2As_2O_3$ or $Cu_3(AsO_3)_2$." And the article finishes by saying there are also two hydrated salts, $CuH_4(AsO_3)_2$, and $CuHAsO_3$. The percentage composi-

* "Traité de Chimie," Tome 1, p. 1152. Paris, 1847.
† "Ure's Dictionary," New York, 1875, p. 1139.
‡ Miller's "Elements of Chemistry," London, 1874, p. 292.
§ Bloxam, C. L., *Journ. Chem. Soc.*, 1862, p. 292.

* "Scheele's Essays." London, 1786, p. 254.
† Vol. i., p. 376.
‡ Vol. iii., 587, 4th ed.
§ "Chemistry, Theoretical and Practical." Lippincott and Co.; Phila., 1876, p. 260.

tion of these salts would be as follows, supposing the above formulæ are correctly given :—

	$(Cu_2O)_3As_2O_3$.	$Cu_3(AsO_3)_2$.	$CuH_4(AsO_4)_2$.	$CuHAsO_4$
Copper oxide (sub. 59·06)	54·61	25·33	42·37	
Arsenic trioxide	40·94	45·39	63·18	52·83
Water	—	—	11·49	4·80

In the first of these formulæ there is an evident mistake; it is a copy of the formula given by Watts, without taking into account that Watts, while doubling the atomic weight of oxygen, retained the old weight of copper. So that, corrected, this formula reads $(CuO)_2As_2O_3$; or, in other words, is Berzelius's formula.

But both of the formulæ, one and two, are wrong, from the fact that they contain no water. No. 3 is an evident attempt to represent the acid arsenite which Berzelius mentions, and No. 4 is Bloxam's formula.

As will be seen, the whole literature of the subject is founded upon three sets of facts. Scheele's prescription, which all the authors whom I have quoted have given, making only such alterations as were necessary on account of changes in weights and measures. And it is a singular fact, that not one of these authors has taken the trouble to see if the quantities of copper sulphate and arsenic trioxide taken would produce a salt of the formula given; or have discovered the fact that nearly twice as much potassium carbonate is used as is necessary to saturate the sulphuric trioxide of the copper sulphate, and Scheele's foot-note has been totally ignored.

Secondly, Berzelius's account of the salt, which has evidently been misunderstood.

Thirdly, Bloxam's analyses of salts, which he would have found difficult, if not impossible, to reproduce had he been so inclined.

After comparing the various works cited, it became a matter of interest to find out, in the first place, what Scheele's green really is, what are its properties, and whether there is more than one copper arsenite.

The experiment was tried of making copper arsenite according to the method given by Berzelius; that is, by dissolving copper carbonate in an aqueous solution of arsenic trioxide.

Hydrocopper carbonate was prepared by precipitating copper sulphate in the cold by an excess of sodium carbonate, and washing the precipitate with cold water until free from sulphates. Some of the precipitate was boiled with a saturated solution of arsenic trioxide, its blue colour soon changed to a bright green, which it maintained, although boiled for upwards of an hour. The green precipitate was filtered off, and washed with hot water, until the wash waters were free from arsenic.

The substance remaining on the filter was of a bright green colour, scarcely inferior to Schweinfurth green in brilliancy, although of a yellowish shade.

The green precipitate was dried and analysed; it gave:—

ANALYSIS No. I.

	Per cents.	Atomic Ratios.
Copper oxide	66·02	8·31
Arsenic trioxide	8·32	0·42
Carbon dioxide	15·26	3·47
Water	10·33	5·74
	99·93	

This corresponds well with a mixture of dibasic carbonate and tribasic arsenite.

The brown basic carbonate produced by boiling the hydrocopper carbonate with water was then boiled with arsenic trioxide, but was not changed in colour. The filtrate from the green precipitate contained a large amount of arsenic, but was free from copper, and I failed to obtain on evaporation the yellowish green acid salt spoken of by Berzelius.

Further experiments on the carbonate were tried to see if it could be completely decomposed by boiling with excess of arsenic trioxide, but they all resulted in failure.

It seems to me that Berzelius must have been misled by the production of the brilliant green arsenio-carbonate, as he gives no analysis to support his assertion.

Arsenic trioxide seems to have a very strong influence in preventing the blackening of copper carbonates and hydrates, a very small percentage preventing this well-known reaction.

A series of experiments were then tried on the production of Scheele's green, following the course laid down in the books and by Scheele himself; viz., first, the production of a more or less basic, sodium or potassium arsenite; and, secondly, the addition of this to a solution of copper sulphate.

Experiment No. 1.

	Parts.	Atomic Ratios.
Copper sulphate, $CuSO_45H_2O$ ..	50	2·04
Potassium carbonate, K_2CO_3 ..	25	1·81
Arsenic trioxide, As_2O_3	10	0·50

Dissolved the potassium carbonate in water, boiled and added the arsenic trioxide, filtered and added to the boiling solution of copper sulphate. The precipitate, when washed and dried, was of a yellowish green; the filtrate was blue.

ANALYSIS No. II.

	Per cents.	Atomic Ratios.
Copper oxide	56·98	7·18
Arsenic trioxide	21·45	1·08
Sulphur trioxide	12·80	1·60
Ferrous oxide	1·60	0·22
Water	7·17	3·98

Experiment No. 2.

	Parts.	Atomic Ratios
Copper sulphate, $CuSO_45H_2O$ ..	50	2·04
Potassium carbonate, K_2CO_3 ..	30	2·17
Arsenic trioxide, As_2O_3	15	0·76

Treated as before; filtrate, pale blue; precipitate, a brighter green than No. 1.

ANALYSIS No. III.

	Per cents.	Atomic Ratios.
Copper oxide	49·58	6·24
Arsenic trioxide	32·12	1·62
Sulphur trioxide	4·42	0·55
Water	13·88	7·82

Experiment No. 3.

	Parts.	Atomic Ratios.
$CuSO_45H_2O$	50	2·04
K_2CO_3	40	2·90
As_2O_3	10	0·50

Treated as before; filtrate, pale yellow; precipitate had more of a yellowish tinge than before.

ANALYSIS No. IV.

	Per cents.	Atomic Ratios.
Copper oxide	51·26	6·43
Arsenic trioxide	31·67	1·60
Sulphur trioxide	5·32	0·66
Water	11·75	6·53

Experiment No. 4.

	Parts.	Atomic Ratios.
$CuSO_45H_2O$	50	2·04
K_2CO_3	50	3·61
As_2O_3	18	0·90

The potash and arsenic were dissolved and allowed to cool, then added to the cold solution of copper. The mixture effervesced strongly; half of it was allowed to stand until next day, then filtered; the other half was boiled, which operation it stood without blackening. Analysis of the first half gave—

ANALYSIS No. V.

	Per cents.	Atomic Ratios.
Copper oxide	49·55	6·24
Arsenic trioxide	38·90	1·96
Water	11·55	6·42

The second half gave—

ANALYSIS No. VI.

	Per cents	Atomic Ratios.
Copper oxide	46·65	5·87
Arsenic trioxide	42·04	2·17
Water	10·41	5·78

This preparation was repeated, using the same proportions; the precipitate was boiled, and washed with hot water until the filtrate was free from arsenic.

ANALYSIS No. VII.

	Per cents.	Atomic Ratios.
Copper oxide	51·40	6·47
Arsenic trioxide	39·57	1·99
Water	8·72	4·85

This seems to indicate that either the salt is decomposed by washing with hot water, or that it consists of a strongly basic salt mixed with free arsenious acid. The first view is most likely the correct one, if we modify it so as to read: "it is decomposed by washing with either hot or cold water, forming a more basic salt."

But further experiments seem to show that this decomposition is much slower with cold than with hot water. And I have found it utterly impossible to remove the whole of the arsenic by prolonged washing.

This fact was further confirmed by an experiment of Prof. J. M. Ordway, who washed a portion of the salt with 3000 times its weight of water, without completely decomposing it. The basic salt produced by washing does not blacken on boiling with water, thus showing that we have a true basic salt or mixtures of several basic salts, and not a mixture of Bloxam's normal arsenite, $HCuAsO_4$, and hydrate of copper.

Experiment No. 5.

In order to see if the salt $HCuAsO_4$ could be prepared by taking the exact amount of arsenic trioxide and copper sulphate necessary to form it, the following proportions were taken:—

	Parts.	Atomic Ratios.
Copper sulphate	124·8	2
Arsenic trioxide	49·5	1
Sodium carbonate	53·0	2

The solution of arsenic in the sodium carbonate was boiled, and added, while boiling, to the solution of copper sulphate. And the ebullition was continued till all the carbonic acid was driven off. The precipitate was washed by decantation once or twice, and then divided into three portions; the first was merely drained, the second was washed a little, and the third was washed until arsenic ceased to be found in the wash-water. These portions were numbered respectively, VIII., IX., X. They all contained basic copper sulphate, and No. VIII. probably contained a little sodium sulphate.

ANALYSIS No. VIII.

	Per cents.	Atomic Ratios.
Copper oxide	49·78	6·27
Arsenic trioxide	35·93	1·80
Sulphur trioxide	6·07	0·76
Water	7·56	4·20
	99·34	

ANALYSIS No. IX.

	Per cents.	Atomic Ratios.
Copper oxide	47·71	6·00
Arsenic oxide	43·74	2·21
Sulphur trioxide	3·10	0·39
Water	5·47	3·04
	100·02	

ANALYSIS No. X.

	Per cents.	Atomic Ratios.
Copper oxide	57·77	7·27
Arsenic oxide	27·50	1·39
Sulphur trioxide	5·27	0·66
Water	8·97	4·98
	99·51	

None of the above blackened on boiling with water, and all gave a blue solution with ammonia. Nos. VIII., IX. closely approximate a mixture of tribasic sulphate with Bloxam's salt; while No. X. is more basic than the formula for triarsenite calls for.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, January 25th, 1876.

The PRESIDENT in the Chair.

THE following paper was read by the Secretary:—

"*On the Retardation of Chemical Reactions by Indifferent Matters, Especially Glycerin,*" by Dr. G. LUNGE.

The observations described below were occasioned by a number of experiments made on behalf of the Swiss Government, for the purpose of discovering a more reliable method of "obliterating" postage stamps than those hitherto in use. Among the stamping inks I prepared with that intention, there were several with a basis of glycerin, and I soon observed that, if any acids were present in such mixtures, they comported themselves differently to colouring matters than if the same acids were used merely in dilution with water. This led me to make some experiments of a simpler nature, and, although I have been prevented by want of time from following them up very far, and from extending them to that point which a true scientific treatment would require, I venture to lay them in that incomplete state before this Society, in the hope that they may not be found quite uninteresting, and that perhaps some one else will take the matter up with more leisure than I have had at my command.

My principal experiments were made upon the behaviour of wrought-iron (in the shape of wire nails) toward a mixture of glycerin and a hydrochloric acid. The hydrochloric acid contained 26·1 per cent. of real HCl, and was mixed with an equal volume of pure, syrupy, glycerin. Check experiments were always made with the same hydrochloric acid, mixed with the same volume of water. Fuming hydrochloric acid can be mixed with glycerin easily in every proportion; nor does it act upon the latter chemically, at least, not at the ordinary temperature, at which all my experiments were performed. Although the formation of monochlorhydrin would seem to be excluded by the very conditions of the experiment, I made sure of it by titrating the mixture before use, and, as may be imagined, I found its percentage of HCl exactly as calculated from the dilution, just as if the diluting fluid had been water instead of glycerin. The acid diluted with glycerin in many cases behaves precisely like that diluted with water; for instance, towards sodium carbonate, calcium carbonate, silver nitrate, sodium hyposulphite solution of chloride of lime, litmus, &c.; at least, no difference could be noted in the preliminary tests, and it thus seemed unnecessary to make quantitative trials. A difference was, however, noted in the case of paper stained blue by ultramarine. Whilst a strip of it in the acid diluted with water is beginning to be bleached ten seconds after immersion, and has become perfectly white in thirty seconds, another strip, dipped in the acid diluted with glycerin, only begins to be bleached after the lapse o

forty-five seconds, and is only thoroughly whitened in four minutes.

The difference is, however, much more decisive in the action of the two acids upon iron or zinc. A bright wire nail (weighing 0·4927 grm.) completely dissolved in 6 c.c. of the acid diluted with water in ten hours' time, apart from a small carbonaceous residue. On the other hand, a nail (weighing 0·4875 grm.) immersed in 6 c.c. of the acid diluted with glycerin, weighed—

After 24 hours, 0·4200 = 86·2 p. c. of the original weight.
" 3 days, 0·2764 = 56·6 " " "
" 6 " 0·1405 = 28·8 " " "
" 14 " 0·0063 = 1·3 " " "

The solution still contained free acid, and behaved in every respect like an ordinary acid solution of ferrous chloride; for instance, towards precipitating reagents.

In another experiment, there were immersed:—

(*a*). A nail weighing 0·385 grm. in 20 c.c. of acid diluted with water.

(*b*). A nail weighing 0·450 grm. in 20 c.c. of acid diluted with glycerin.

The evolution of gas (similarly to the previous cases) was much stronger in the case *a* than in the case *b*. After the lapse of three hours both test-tubes containing the iron and acid mixtures were closed by gas delivery tubes, and coanected with graduated cylinders inverted over a pneumatic trough. Eighteen hours later there had been collected from the tube *a* 74 c.c. of hydrogen gas, whilst the iron in it was completely dissolved. The experiment *b* was interrupted forty-four hours after the connection with the graduated cylinder, when only 52 c.c. of gas had been collected, and more than half of the nail was still left undissolved.

The action of the two acids on graduated zinc was much more rapid, but still showed a marked difference. 1 grm. of zinc, with 20 c.c. of acid and water, evolved 200 c.c. of gas in one and a half minutes; 1 grm. of zinc with 20 c.c. of acid and glycerin took eight minutes to produce the same result. Other experiments, always with a similar result, were made with iron borings and hydrochloric acid; also with iron borings and sulphuric acid, diluted in one case with four volumes of water, in the other with four volumes of glycerin.

The cause of the retardation of the action upon metals in the case of acids diluted with glycerin can hardly be a purely chemical one, since, on the one hand, the glycerin is not acted upon, and since, on the other hand, it does not itself act either upon the [illegible] upon the product of the reaction. The latter (ferrous chloride) is easily soluble in glycerin, as was proved by independent experiments, and it cannot, therefore, be presumed that the case is analogous to the insolubility of some metals in concentrated acids. Probably the real cause is—at least, partly—the viscosity of the glycerin, which is perfectly apparent even in the mixture with acids. The gas bubbles cannot liberate themselves very quickly from the iron, and thus prevent the contact between it and the acid. This assumption is supported by the fact, that the attack of acid upon iron is much more weakened by dilution with a solution of gum arabic than with pure water, as I found on trying it. But this explanation does not hold good for the retardation of the action of hydrochloric acid upon ultramarine, as well as in several other cases observed by me, and the following experiments do not in any way seem to be compatible with it. If fuming hydrochloric acid, diluted with the same bulk of water, be mixed with a little lamp-black (moistened with a drop of alcohol, to make the acid wet it) and if iron nails are immersed in the mixture, they are so little acted upon, that the evolution of gas is hardly perceptible at all; twenty-four hours after the nail looks exactly as it did at first. But if the mixture be now thrown upon a filter, and the same nail be placed in the acid running through the filtering paper, a strong evolution of gas commences immediately, and the nail is dissolved very soon.

The following quantitative experiments were made with a mixture of 50 parts of glycerin with 30 parts of fuming hydrochloric acid, and 3 parts of lamp-black. A nail weighing 0·536 grm. produced only after some hours a few minute bubbles of gas, and showed the following weights:—

After 3 days, 0·4780 = 89·2 p. c. of the original weight.
" 6 " 0·4001 = 74·6 " " "
" 14 " 0·2575 = 49·0 " " "

In another experiment, a nail of 0·5766 grm. weighed—

After 3 days, 0·5124 = 88·8 p. c. of the original weight.
" 6 " 0·4440 = 77·0 " " "

The experiment was then interrupted by filtering the mixture. In the filtrate, 92 per cent of the acid could be proved analytically; the remaining 8 per cent might easily have been lost by incomplete washing of the slimy carbonaceous residue; but in any case there was far more acid in the filtrate than sufficient for dissolving the nail, and, in fact, the same placed in the filtrate at once caused an evolution of gas, certainly only at a moderate rate, as explicable by the presence of glycerin, and by the large dilution with the washing-water. Zinc behave in exactly the same way towards the same mixture.

It does not seem impossible that this retarding action of indifferent substances may find a useful application, both for moderating chemical reactions in scientific operations, and in technical operations on the large scale. It would give me great pleasure if this subject were pursued further by one interested in it, and if a satisfactory explanation of that phenomenon were suggested.

NOTICES OF BOOKS.

Jahresbericht über die Fortschritte aus dem Gebiete der reinen Chemie. By Dr. W. Staedel. Tübingen: H. Laupp.

The knowledge of the German language is now so common among English chemists that many German publications have an extensive circulation in this country. And great difficulty is experienced in acquiring information on special points, owing to the great numbers of the journals in which memoirs are published, and to the various languages in which they are written. This want has been felt, and attempts have been made to rectify it, by the abstracts of chemical papers published in the *Journal* of our own Chemical Society, and also in the list of titles at the end of the *Berichte* of the German Chemical Society. The *Jahresbericht der Chemie*, which had for its object not merely to furnish references, but also to give short sketches of the subjects of the memoirs, is now some years behind date. Its arrangement, moreover, made it difficult at once to refer to any desired subject, and its cost put it out of the reach of many who would otherwise have bought it. To supply these deficiencies Dr. Staedel, of Tübingen, with the help of able coadjutors, has, for the last three years, edited the *Jahresbericht der reinen Chemie*. It is provided with a full index and a copious and well-arranged table of contents, with references to all the original papers of which short abstracts are made.

The arrangement of the work is as follows:—

I. General Chemistry.
II. Inorganic Chemistry. 1. Metals. 2. Metalloids.
III. Organic Chemistry.
A. Fatty Series. 1. Hydrocarbons. 2. Monatomic Alcohols. 3. Unsaturated Hydrocarbons. 4. Polyatomic Alcohols. 5. Carbo-hydrates. 6. Acids, Aldehyds, and Ketones. 7. Cyanides. 8. Amides, Amines, and Phosphines. 9. Amides of Carbonic Anhydride. 10. Uric Acid and its Derivatives.

B. Aromatic Series. 1. General Remarks. 2. Benzol Compounds, Amido-, Sulpho-, and Oxy-Substitution Compounds. 3. Toluol. 4. Zylol, &c. 5. Diphenyl, Tetraphenyl, &c. 6. Terpenes. 7. Camphor Group.

C. Naphthalene, Anthracene, Phenanthrene, &c.

D. Glycosides; Unclassified Animal and Vegetable Compounds.

IV. Theoretical and Physical Chemistry, comprising Thermo-Chemistry and Optical and Physical Chemical Investigations.

V. New Apparatus and Lecture Experiments.

It is thus evident that the arrangement is thoroughly systematic.

It need hardly be remarked that investigators would materially further the object of this work, as well as render their investigations more widely known, by sending a copy of their memoir to the Editor. The *Berichte* is published in August, and its cost is about eleven shillings.

Notes on Milk, with Plain Directions for its Preservation in the Dairy, its Safe Transit by Railway, and an Exposition of its Dietetic Qualities generally. By R. J. ATCHERLEY, Ph.D., F.C.S. London: Published by the Author, 22. St. Mary Axe, E.C.

WE have here a pamphlet containing little but what is true, and also little that can be considered novel. The author thinks the "time must soon be at hand when sophistication will be completely checked." Yet he complains that the "Public Analysts of the day ground their statement of adulteration, or the reverse, upon the percentage of solids they find in the milk," and maintains that "milk varies exceedingly within certain limits." We perceive here an error: Public Analysts are generally guided not by the total percentage of solids, but by the proportion of "solids not fat,"—a much more constant quantity. We might ask, further, Upon what does Dr. Atcherley found his statement as to the variability of milk —upon hundreds of determinations of *genuine* samples made by himself, or upon results obtained by others making use of obsolete methods? But admitting, for argument's sake, that the composition of milk is very variable, we have then to enquire—How is "sophistication to be completely checked"? The author does not appear to have any more accurate method to propose in lieu of the determination of solids. If the milk-trade are informed, through a pamphlet expressly addressed to the proprietors of dairy-farms, that merely "a *crude* notion of the extent of the adulteration may be arrived at on considering the chemical and physical appearances jointly," we fear that the pump will be plied with increasing vigour.

Annual Announcement of the Stevens Institute of Technology, a School of Mechanical Engineering founded by E. A. Stevens, Esq., of Hoboken, New Jersey.

WE have often had occasion to point with admiration to the colleges and institutions for the promotion and diffusion of science, founded by the princely munificence of private citizens. We hold that the industrial eminence of a nation depends far more on placing the means of a sound scientific training within the reach of those who desire it, than upon forcing elementary schooling upon those who have no intellectual cravings. Among the colleges of the kind in question no mean rank belongs to the Stevens Institute of Technology, founded in 1870, and now in full and successful operation. In demonstration of its efficiency we may, on the good old principle that "the proof of the pudding is in the eating," refer to the contributions to Science that have emanated from the Stevens Institute during the five years of its active career. Thus Dr. H. Morton, the president of the college, has given to the world papers on the "Fluorescent Relations of Anthracen and Chrysogen," on the "Fluorescent Relations of a New Hydrocarbon found in Petroleum Distillates," on the "Fluorescent Relations of Chrysene and Pyrene," on the "Fluorescence and Absorption Spectra of the Uranium Salts," on "Certain Basic Salts of Uranium," on "Apparatus and Methods of Optical Projection," and on "A New Form of the Bunsen Burner," all of which have appeared in the CHEMICAL NEWS. Prof. Leeds, who worthily fills the chemical chair, has contributed papers on the "Spectroscopic Examination of Silicates," on the "Volumetric Determination of Chlorine," on the "Purification of Mercury," on "Alizarin as a Test," on the "Alteration of Albite and the Genesis of Deweylite," on "Unusual Occurrences of Phosphoric Acid," on a "Rapid Method of Double Weighing," on a "General Method of Spectroscopic Examination," and on the "Dissociation of Certain Compounds at Very Low Temperatures," in addition to valuable contributions to mineralogy. Prof. C. F. Kroeh has furnished papers on "Recent Developments in Quantitative Spectrum Analysis," on the "Magnetic Spectrum," on "Recent Progress in Electro-Magnetism," besides other memoirs. If we reflect that chemistry of necessity plays but a secondary part at the Stevens Institute, whose main functions are mechanical, we may certainly congratulate it on the position it has already taken, and on the future career of usefulness to which it may look forward.

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—A point of some importance in the analysis o waters by Wanklyn and Chapman's method has lately been brought to my notice in a letter which I have just received from my brother, who is Demonstrator in the Mineralogical Laboratory of the University of Sydney.

In that laboratory a series of analyses of waters have been recently carried out, and it has been found that the amount of ammonia (free and albuminoid) varies very considerably according to the age of the sample.

I quote from my brother's letter: "I have made some 200 determinations of well-water, rain-water, pond-water, distilled water, distilled + urine, distilled + white of egg, and so on, and I find that a series of, say 12 or 20 bottles, all filled from the same source (well mixed) alter daily in the quantities of free and albuminoid ammonia; some of the samples free themselves from free ammonia quickly in ground-glass-stoppered bottles, others increase; even the albuminoid ammonia increases and decreases without apparently any fixed law."

Another quotation from the same letter is interesting:—"Distilled water, re-distilled in a clean copper still with sodium carbonate, first portion of distillate rejected: 3 litres collected, free from ammonia by Nessler's test, distilled this with 300 c.c. permanganate solution, and 180 c.c. saturated sodium carbonate solution; 1 litre, free from ammonia by Nessler's test, collected, re-distilled this with 60 c.c. sodium carbonate, and 100 c.c. permanganate solution; 500 c.c. collected free from ammonia; kept 38 days in ground-glass-stoppered bottle; determined free ammonia = 0·09 m.grm. per litre; albuminoid ammonia, none. One series of urines gradually decreased from 0·5 m.grm. per litre, in 14 days, to 0·005 m.grm. per litre." I cannot say whether the last quoted numbers refer to free or to albuminoid ammonia. My brother is still engaged with experiments bearing upon these results, and promises me full details when they are finished. I should be very pleased to learn whether any chemists who have had large experience in water analysis can corroborate these results; also whether, granting their accuracy, any plausible explanation of the facts can be given. Is it possible that the "germs" which have escaped decom-

position by the permanganate undergo a process of gradual decomposition in the water, and that ammonia is one of the products of this process?—I am, &c.,

M. M. PATTISON MUIR.

The Owens College, February 23, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 6, February 5, 1877.

Oxide of Monochlorated Methyl.—M. C. Friedel.—The author finds that it is possible to form a stable group by replacing the chlorine in methyl-monochloric oxide with oxacetyl.

Diathermanous Character of Metals and of Paper.—M. Aymonnet.—Metals and paper are not athermanous, as is generally supposed. They are more diathermanous for obscure heat emanating from metallic bodies raised to a temperature below 100° than for thermic radiations which are luminous or bordering upon redness. Their absorbent powers are lower than that of water. It is possible to find a mathematical relation between the absorbent power of a body and its coefficient of conductibility.

Presence of Free Ammonia in Cast-Steel.—M. P. Regnard.—On breaking up ingots of steel made on Pousard's system the author noticed a very decided smell of ammonia. The odour was accompanied by a slight hissing, very distinct on holding the ingot to the ear. On covering the fracture with soap-water a froth was produced. These phenomena were witnessed by several persons, especially MM. Troost and Hautefeuille.

Effects of the Injection of Magenta into the Blood.—MM. V. Feltz and E. Ritter.—The authors find that the injection of pure magenta occasions paralysis, or convulsive agitation of the limbs.

Mineralogical Structure and Composition of Variolite from the Durance.—M. A. Michel Levy.—Not adapted for abstraction.

Determinations of Ammonia in the Air and in Meteoric Waters.—M. A. Levy.—The methods employed by the author present nothing remarkable.

No. 7, February 12, 1877.

Researches on Thermic Spectra (continuation).—M. P. Desains.—In a paper published in 1870 the author has shown that in the solar spectrum formed with an apparatus of rock-salt the heat which accompanies the luminous rays is about one-third of the total heat; on the other hand, in the spectrum of incandescent platinum it is a mere insignificant fraction. We arrive at analogous results with an apparatus of flint glass. The difference does not disappear on transmitting the rays of the incandescent metal through strata of water of greater or less thickness. The spectra of the electric light are much more similar to those of the sun, as the heat extends even into the blue.

A New Catalogue of Coloured Stars, and on the Spectrum of Schmidt's Star.—P. Secchi.—In Schmidt's star, in the constellation Cygnus, the author has verified the brilliant lines of hydrogen and magnesium and the yellow ray of sodium.

Adulteration of Food.—General Morin, M. Pasteur, and M. Dumas insist that the presence of magenta in wines, and of copper in preserved vegetables, is to be considered as a fraud, quite irrespective of the more or less decidedly poisonous character of these additions, and demand the absolute suppression of the practice.

Nitrification by Organic Ferments.—MM. Schlœsing and Müntz.—The authors maintain that organic matter and ammonia are burnt in the soil by oxygen, under the mediation of organic germs.

Certain Alterations in Glass.—M. V. de Luynes.—The author finds that certain glasses, after long exposure to light, undergo a change which causes them to act upon polarised light in the same manner as tempered glass. If heated, a layer exfoliates, which is richer in silica than the interior mass. If this outer coating is broken, and water penetrates to the interior, the glass is soon destroyed.

Phosphorescent Organic Bodies.—M. B. Radziszewski.—The author has shown the existence of well-defined organic bodies—such as hydrobenzamide, amarin, and lophin—which are luminous in the dark if brought in contact with an alcoholic solution of potassa.

Fermentation of Urine.—Dr. H. C. Bastian.—A reply to M. Pasteur's last paper on spontaneous generation. M. Pasteur afterwards requested the Academy to nominate a commission to investigate and report, and expressed the hope that Dr. Bastian would make a similar application to the Royal Society.

Poisonous Character of the Salts of Copper.—M. Bergeron.—The author, in opposition to M. Galippe, declares that copper, even if innocuous in minute doses, is a poison, and that verdigris is not admissible in articles of food.

Means of Detecting Iodine in Cod-Liver Oil, and Experiments on the Absorption of Iodide of Potassium by Fatty Animal Matters.—M. B. Barral.—The author burns the oil in a small apparatus, described and figured in his original memoir, and searches for the iodine in the aqueous products of combustion. He finds by direct experiment that the milk of herbivorous animals, submitted to an iodised diet, contains iodine not merely in the serum, but also in the fatty matter.

Bulletin de la Société Chimique de Paris, No. 12, December 20, 1876.

Detection of Magenta in Wines.—M. Fordos.—Second paper; already noticed.

Products of Condensation of the Ortho-Homologues of Benzol.—M. Bohuslaw Reyman.—A preliminary notice.

Relation Between the Chemical Equivalents and the Absorbent Powers of Bodies for Heat.—M. Aymonnet.—The author concludes that the absorbent atomic power seems to be constant—First, for simple bodies dissolved in the same medium; second, for simple bodies forming part of compounds of an analogous chemical constitution. Heat, he considers, has only one way of propagation, from atoms to atoms. The following law is proposed:—When the temperature of the source of a given nature rises, the absorbent power of the bodies submitted to the radiations of this source diminish all in the same proportion.

Dichlorated Naphthalin Corresponding to Nitro-naphthyl-sulphurous Acid.—M. P. Cleve.—The author has obtained the dichlorated naphthalin in question in flat needles, readily soluble in boiling alcohol, but sparingly in cold alcohol, and fusible at 107°. On analysis 36·12 per cent of chlorine was found, instead of the 36·04 which the formula requires.

Determination of Arsenic by Standard Solutions.—MM. P. Champion and H. Pellet.—The process consists of the following operations:—Transformation of the arsenic into a sulphide; solution of the sulphide of arsenic in ammonia, and saturation with acetic acid; titration the arsenic with iodine in presence of starch.

Justus Liebig's Annalen der Chemie,
Band 185, Heft 1.

Communication from the Laboratory of the University of Halle. This consists of a paper on nitrosotriacetonamin, by W. Heintz.

On Picrorocellin.—J. Stenhouse and C. E. Groves.—Taken from the *Proceedings of the Royal Society.*

Communications from the Laboratory of the Pharmaceutical Institution in Breslau.—These consist of two papers by Dr. Moslinger, "On the Ethereal oil of the Fruits of *Heracleum Sphondilium*," and "Preparation and Description of Certain New Octyl Compounds."

Reten and Certain of its Derivatives.—A. G. Ekstrand.—Reten forms the chief part of a fatty substance known in Germany as tar-tallow (*Theer-talg*), and obtained as a semi-fluid oil towards the end of the operation of distilling wood-tar. The paper is very long, and incapable of useful abstraction.

On Maclurin.—R. Benedikt.—The author concludes that protocatechuic acid and phloroglucin are the only proximate constituents of maclurin.

Diethyl-methyl-acetic Acid, a New Isomer of Œnanthic Acid.—E. Schdanoff.

Pinakon and Pinakolin Formed from Methyl-ethyl-keton.—G. Lawrinowitsch.—These two papers are reprints from the *Bulletin of the Imperial Academy of Science of St. Petersburg.*

Revue Universelle des Mines,
Sept., Oct., Nov., and Dec., 1876.

The only chemical matter in this issue consists of extracts from the *Comptes Rendus.*

Reimann's Farber Zeitung.
No. 5, 1877.

This issue is taken up with notes on machinery, an extract from certain lectures on woollen dyeing delivered last year before the Society of Arts, and a few receipts.

No. 6, 1877.

This issue contains a paper on the progress of the "hydrosulphite" vat, and an account of an action brought by a silk merchant in England against a dyer for not "weighting" certain black silks to the extent desired. We are happy to find that the plaintiff was unsuccessful.

No. 7, 1877,

The principal article in this number treats on brasilin, which, in accordance with the recent researches of Liebermann and Burg, is considered a lower stage of oxidation of hæmatoxylin, to which it bears the same relation as does alizarin to purpurin. There is a useful caution against practical joking in dye-works and similar establishments. A case [illegible] Rouen took, as is easily conceivable, [illegible]

Moniteur Scientifique, du Dr. Quesneville,
February, 1877.

Observations on the Definition of Salts.—M. Felix Bellamy.—A bulky treatise extending to nearly thirty pages, and incapable of useful abstraction.

Migration of Gases.—M. Felix Bellamy.—Already noticed.

Combinations of Phthalic Acid with Phenols.—Adolf Bayer.—A translation from the *Berichte der Deutschen Chemischen Gesellschaft.*

New Physiological Researches on Pure Magenta.—MM. Bergeron and Clouet.—The authors contend as the result of their experiments that *pure* magenta is absolutely innocuous.

New Means of Synthesis by Means of Nascent Formic Acid.—K. Reimer and F. Tiemann.

Action of Tetrachloride of Carbon in an Alkaline Solution on Phenol (Formation of Salicylic and Paroxybenzoic Acids).—K. Reimer and F. Tiemann.

Constitution of the Compounds of the Coniferylic and Vanillic Series.—F. Tiemann and B. Mendelsohn.

Hydrochlorate of Glycosamine.—G. Ledderhose.

These four papers are extracts from the *Berichte der Deutschen Chemischen Gesellschaft.*

Benzolic Nucleus of M. Mehay.—M. Noelting.—A hypothetical note extracted from the *Annalen der Chemie.*

Les Mondes, Revue Hebdomadaire des Sciences,
No. 1, January 4, 1877.

Phenomena of the Synthesis of Gases in Plants.—M. Merget.—Two cylindrical glass jars of 300 c.c. capacity were placed with their open ends in a large vessel of water. The one was filled with hydrogen, the other with oxygen, and they were connected internally by a branch sufficiently long to reach their extremities. The level of the water gradually rose in each cylinder, and the gases ultimately disappeared. At the beginning of the experiment the volumes which disappeared were almost equal, but as the level of the water ascended in the two cylinders, and as the emerging portions of the branch became shorter, the volume of hydrogen disappearing approached more and more nearly to double the volume of the oxygen. If a similar experiment was made with hydrogen and nitrogen in the two cylinders, the volume of the former gas which disappeared was three times as great as that of the latter. On operating with hydrogen and carbonic oxide the two gases still disappeared, but in very variable proportions.

NOTES AND QUERIES.

Steel Analysis.—Would any of your numerous correspondents describe a method for the determination of tungsten and titanium when present together in a sample of steel?—CHEMIST.

Black Pigment or Dye.—A few years ago the discovery of a new *black* was announced. I think it was in your excellent journal, which, as stated, placed in juxtaposition with ordinary black, the latter looked pale. I shall be much favoured if you or any correspondent can kindly inform me whether this black is suited for use as a pigment or a dye for the surfaces of wood, paper, or metal, and where it can be procured?—W. R.

Rusting of Steel.—I am much annoyed by the rusting of steel springs employed in the valve cases of a "Euphonium;" directly the silver plating wears and exposes the steel, galvanic action helps the destruction of the springs; the wet to which they are exposed is of a very corrosive nature. Can I in any way protect steel so that it can be used in the situation mentioned; the usual springs are of brass, but they have the defect of soon losing their power and being rather sluggish in their action.—F.R.M.S.

Iron.—A sample of iron-ore which consisted almost entirely of Fe_2O_3 was dissolved in HCl, HNO_3 added, and boiled, to entirely peroxidise any protoxide that might be present, the solution filtered from the siliceous matters, the filtrate precipitated with an excess of NaHO and boiled; the Fe_2O_3 thus separated was filtered off, washed, and re-dissolved in HCl; again precipitated with NH_3, collected on a filter, washed until free from chlorine, dried, and ignited with the usual precautions where reduction is to be apprehended. The precipitated when dried was of a *very dark colour*, was ignited separately from the filter ash in a porcelain crucible over a spirit-lamp upo cooling was of a dark shining lustre approaching black, and found to be magnetic. moistened with HNO_3 and re-ignited was still magnetic this should not be with Fe_2O_3. Will some of your readers who are constantly working on Fe_2O_3 kindly point out the cause? Consequently, what I have omitted to do and any other information on the subject will be esteemed.—PEROXIDE.

[See notes by J. Robbins, CHEM. NEWS, vol. i., pp. 11, 119.—*Ed.* C.N.]

TO CORRESPONDENTS.

E. B.—Paper may be parchmentised by soaking in moderately strong sulphuric acid, and then well washed.

W. K.—(1) "Watts's Dictionary of Chemistry." (2) Of any dealer in minerals, or if you want large quantities you should advertise.

THE CHEMICAL NEWS.

Vol. XXXV. No. 902.

CONTRIBUTIONS TO VOLUMETRIC ANALYSIS.*

By P. CASAMAJOR.

First Paper.—On a New Portable Burette.

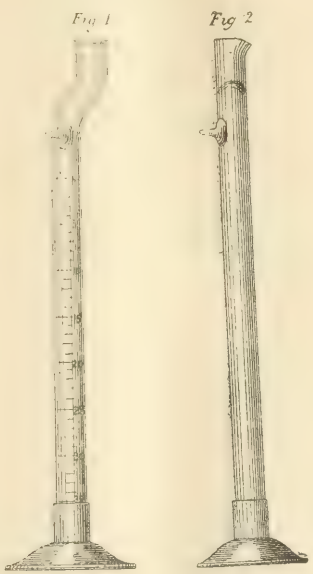
The necessity of estimating potassa and soda in their commercial carbonates with accuracy and rapidity, gave rise to volumetric analysis, and I believe that Descroizilles was the first chemist who substituted the measuring of a certain volume of acid of known strength for the slower and more delicate operation of weighing.

To ascertain the exact volume of sulphuric acid required to saturate a known weight of alkali, Descroizilles used a graduated tube about 25 centimetres high, with a diameter of 15 millimetres. This was provided with a very narrow neck, whose upper portion was expanded and provided with a lip. On the shoulder, near the base of the narrow neck, was a small opening, which, by being closed more or less perfectly, by the application of a finger, allowed the titrated acid to run out with more or less rapidity. The word *burette*, applied to this instrument, was very appropriate, as in French *burette*, as defined by Boiste,† is a small flask with a narrow neck, and is a diminutive of *buire*, which means a large flask. This word was adopted afterwards by Gay-Lussac to designate his graduated drop tube, and it has been applied to all instruments designed to fulfil the same purpose, whatever be the variety of their shapes.

In the burette of Gay-Lussac, which was the immediate successor of the instrument of Descroizilles, the liquid is poured out through a very narrow tube, which may have been suggested by the narrow neck of the primitive flask. This burette has the advantage over some other forms now adopted that it is made entirely of glass, and is therefore able to hold any of the test liquors used in volumetric analysis, and also that its contents can only run out when the instrument is in the hands of the operator. I believe that it is generally preferred to other forms, and that more of them are sold than of any other kind. Two other burettes are in general use, in both of which the liquid drops directly from the bottom of the graduated tube, its flow being regulated either by a glass cock, or by a pinch cock acting on a flexible rubber tube. This latter instrument is the invention of Dr. Frederick Mohr, and we may say of it that, for solutions which have no action on india-rubber, no better burette could be desired.

In the investigations which I lately made on the "Estimation of Potassium as Acid Tartrate," which I had the honour of laying before you at our September meeting, I had repeatedly occasion to use a titrated solution of potassic hydrate, which could not be held in Mohr's burette, on account of the rubber tube. A burette with a glass cock, which I used at first, was finally laid aside, as the normal alkaline solution was continually leaking out around the key of the cock. This key itself fitted very perfectly, but it had to be slightly loosened from its seat to allow it to be turned with nicety, and the play left in this manner was sufficient to let a portion of the contents leak out, and, as the whole of this did not find its way to the beaker glass, but some remained on the outside of the burette, errors were committed which materially affected my results. A burette of Gay-Lussac gave much more satisfactory and concordant results, as no leakage took place under any circumstances. This burette, however, is inconvenient to use because a constant watch must be kept on its liquid contents if the outflow is to be regulated with precision, and this is not an easy matter, as the attention of the operator is divided in observing both the outflow and the effect of the test liquor on the solution in the beaker glass. This defect is aggravated by the circumstance that, towards the end of the operation, when the effect of every drop of test-liquor on the solution under examination has to be watched with the closest attention, the management of the burette becomes the most difficult, on account of its greater deviation from a vertical position.

Having suffered a great deal of inconvenience from this defect, I endeavoured to overcome it by several devices, and was finally led to adopt an entirely new form of burette, which I find more convenient than any other with which I am acquainted, and which it is my business to describe to you this evening.



The burette represented in Fig. 1 and Fig. 2, is a cylindrical tube closed at the bottom. For the sake of convenience and safety this tube is inserted in a stand or foot, in the manner proposed by Dr. Mohr for Gay-Lussac's burette. This foot is made of japanned tin, which is better in every way and more economical than wood. The cylindrical portion of this tin stand is only partially soldered on the flat part, to allow the portion left free to act as a spring in holding the glass cylinder tightly.

The upper portion of the glass tube has the shape shown in Fig. 1, to prevent the liquid from running out when the tube is inclined. The same object is usually accomplished by bending the upper portion at an obtuse angle on the main stem; but I have preferred the shape shown in Fig. 1, as the burette is more easily filled while standing vertically on its foot.

Immediately under the curved portion of the burette is a beak, from which the liquid drops when the instrument

* Read before the American Chemical Society, November 7, 1876. Communicated by the author.

† The definitions of Boiste are as follows:—Buire—*s. f.* flacon—grand vase. Burette—*s. f. Urceolus*—petite buire—vase à petit goulot pour l'huile; pour l'eau et le vin à la messe.

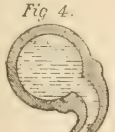
is inclined and properly turned. By making a transverse section through this beak we obtain Fig. 3 and Fig. 4, which show the shape of the beak, and its portion in relation to the stem for two positions of the tube.

To allow the liquid to drop from the burette it is inclined as in Fig. 5, in which position the curved position at the upper end prevents the liquid from pouring out. Keeping the tube inclined as in this figure, we may either prevent the outflow of its contents or allow it to run with more or less rapidity. To effect this it is merely necessary to turn the instrument around its own axis, so that the beak may be either raised or lowered, as shown in Fig. 3 and Fig. 4. When the beak is allowed to take the position shown in Fig. 3, the liquid in the tube does not run out, while in the position shown in Fig. 4, the drops run out quite rapidly. At some intermediate point, it will be found that the liquid runs out slowly in drops, which may be accelerated or retarded by turning the tube around its axis, but without changing the inclination of this axis.

The motion imparted to the burette by holding it in the hand, and simply turning it around its axis is an easy one for the operator, who is not obliged to watch the liquid in the instrument with any degree of attention. As the liquid runs out of the burette it becomes necessary to incline its axis more and more, to keep a supply of liquid near the beak; but there is no difficulty connected with this, as the liquid runs out with equal ease when the instrument is full to the O mark as when it is nearly empty. When the changes which occur in the liquid under examination indicate that the operation is nearly

Fig 3

Fig 4.



ended, the liquid may very easily be made to fall in single drops by turning the beak down gradually, and raising it again with a sudden motion. This is easily learnt by a little practice, and does not require a close watch on the contents of the burette.

The most convenient position for the operator is to hold the tube almost horizontally and to let the foot roll on a block of proper height, while the necessary motions are given to the instrument by holding it with one hand near its open end. This presents the additional advantage that the portion which becomes heated by the hand is not in contact with the liquid contents of the tube.

This position, however convenient, is not necessary, as it does not happen with this burette as with Gay-Lussac's, that almost every time the instrument is partially raised, a little drop of test liquor settles at the end of the small tube and prevents further outflow, which is a source of endless annoyance and delay.* As the beak always remains full of liquid, this new burette is ready to give a drop whenever the tube is properly inclined and turned.

Whenever it becomes necessary to lift the instrument, the beak should be previously raised by turning the tube, as otherwise a drop of liquid may escape and run down the side of the tube. After the operation is ended, the burette should be left in a vertical position for some minutes, to allow the liquid to run down before reading the indication of the scale. As the beak holds by capillarity a certain quantity of test liquor, it will be found convenient to keep it full whenever the indications of the scale are observed. This beak usually becomes filled of itself at the time of filling the instrument with test liquor. The open end of the burette may be provided with a lip on the side opposite to the beak, as shown in Fig. 2. This is to allow the test liquor to run out faster when desired.

Many chemists are unwilling to trust volumetric analysis for fear of the changes of volume which are due to changes of temperature. They are, however, willing to

Fig 5.

Fig 6

use the solutions of this method of analysis, and they have adopted a gravimetric system, which consists in weighing instead of measuring their test liquors. For this manner of using test solutions, I have made the gravimetric burette represented in Fig. 6. The manner of using this burette is precisely the same as for the volumetric instrument, and it does not require any further explanation.

The weight of test solution used in an analysis is best determined by double weighing. The flask or gravimetric burette, containing a greater quantity of test solution than will be required by the analysis, is placed on the scales and counterbalanced with shot or any other material. After the operation is ended, the flask should be replaced on the same pan of the scale and be made to counterbalance the original quantity of shot by adding weights, which represent the weight of test solution that has been used. A common balance weighing 200 grms. and turning to 1 centigrm., is sufficient for this method of testing.

* This occurs principally with alkaline solutions. If the small tube of Gay-Lussac's burette is carefully watched, it will be seen, that when an alkaline solution runs down this tube, the main portion of the liquid fills up the tube; but it is preceded by a low wave, which keeps ahead of the main portion, however fast or slow the liquid runs down. This wave arrives at the nozzle before the other portion and fills it, leaving a volume of air between the two portions. With acid solutions the wave does not exist, and the tube is seldom stopped. The plan usually adopted to renew the flow, when it has been stopped by a drop of liquid at the nozzle, is to blow into the main tube. This is very objectionable, as by blowing we may obtain a small stream but not a drop. Toward the end of an operation this might spoil a test. The possibility of obtaining a drop at any time with ease and certainty is the great desideratum in a burette.

The Chemical Society's Dinner.—We would remind Fellows of the Chemical Society that the Dinner, under the presidency of Professor Abel, will take place at Willis's Rooms on Tuesday week, March 20th. A full gathering may be expected to rally round so popular a president.

PYROLOGY, OR BLOWPIPE CHEMISTRY.

By MAJOR ROSS, late R.A.

(Continued from vol. xxxiv., p. 177.)

A digression from the immediate subject of my last paper on this science may be permitted by my readers for the purpose of briefly examining two interesting articles which appeared in the last number (3) of the *Mineralogical Magazine*.

The first, from the pen of Dr. Foster, the *facile princeps* of pyrologists in England, contains a truly admirable "Defence of the Late Dr. Turner's Method of Detecting Boric Acid in Minerals, &c.," against the attack made upon it (published in the Chemical News, vol. xxxv., p. 36) by Prof. Chapman, of Toronto.

The second article is a too brief review of Part I. of the fifth edition of Plattner's "Probirkunst," &c., just published by Prof. Richter, of Freiberg; evidently written by some-one well acquainted with the subject.

With reference to Turner's boric acid test, Prof. Chapman stated (1) that it "fails entirely" to detect boric acid in *borax*; and (2) that "most other borates and borosilicates colour the flame equally well *per se*."

As sodium, or rather the orange flame which sodium salts exhibit more strongly than any other substance, is the chief preventer of the recognition of boron in a flame, Dr. Foster details six experiments, the last of which shows the effect of the combustion of a mixture of 99 parts of common salt with 1 of borax, which, by Turner's method showed, on the edge of a Bunsen flame, "a decided green colouration." Before the blowpipe this mixture failed to give any indication of boric acid, but one of 98 parts salt with 2 of borax "gave a decided green" before the blowpipe.

These careful and conclusive experiments must surely satisfy Prof. Chapman of the general erroneousness of his first assertion, the rather that he does not appear to have made any inductive experiments in the matter himself.

As regards Prof. Chapman's second statement, that minerals containing borates colour the blowpipe flame *per se*, it is amazing to think he should chiefly depend for its verification upon the assertion of a French gentleman, Buzengeiger, made in 1829, who, moreover, according to Prof. Chapman's own quotation, says he was so unaccustomed to the use of the blowpipe that he could not succeed in obtaining an indication of boric acid from a borate by the use of Turner's flux (!)

After such a confession as this, there is nothing surprising, and still less convincing, in the additional statement that he deluded himself and some few others into the idea that "tous les mineraux que M. Turner a vu colorer la flamme en vert en les melant avec son flux m'ont donné la meme réaction en les introduisant avec quelque soin dans la flamme bleue, sans les mélanger avec aucun réactif." "Methinks" M. Buzengeiger here, "doth prove too much."

Prof. Chapman states that "all specimens of *Axinite* colour the flame green, *per se*," and if green-yellow is to be termed "green" the statement may be allowed to pass without criticism; but he does not assert that specimens of *Tourmaline* do anything of the sort, although by the use of Turner's flux most afford a vivid boron green for a few seconds.

The real defect of Turner's method is that the reaction is too ephemeral. I have attempted to remedy this defect by the use of a solution of copper (*vide* "Pyrology," pp. 191, 192), and I should be glad to hear if Dr. Foster has tried and succeeded by my method with (for instance) such minerals as *Tourmaline* ?*

The want of a thoroughly effective pyrological test for boric acid is the more felt, because such could probably be made *quantitative*; and, according to H. Rose ("Chemie Analytique," vol. ii., p. 939, 1862)—"The quantitative determination of boric acid presents great difficulties: if in aqueous solution the total quantity cannot be determined by evaporation, and if in alcoholic solution it is volatilised by evaporation, even when conducted by very gentle heat, in still greater quantity than in an aqueous solution."

"Plattner's Assaying with the Blowpipe," fifth edition, Leipsic, 1877, edited, as before, by Prof. Richter, Director of the Freiburg School of Mines, has just issued (or, at least, Part I., containing about one-fifth of the entire book has issued) from that celebrated university.† The reviewer, evidently an experienced pyrologist himself, states that "the amount of new matter in the first part seems to be small, and has been introduced at the expense of some portions of the previous edition, for 144 pages of the new edition cover the same ground as 148 of the old. This diminution in size is partly due to the use of smaller type." After stating that potassium iodide and sulphur for detecting bismuth find a place among reagents here, which they did not in the last edition—though, by the way, the whole reaction is detailed in Prof. Cornwall's translation of the fourth edition, in the appendix—the reviewer goes on to say—"Reference is made to the labours of Emerson, G. Rose, Sorby, and Wunder, but we are surprised to find that no notice whatever is taken of Major Ross's work on 'Pyrology.' Surely Prof. Richter must have seen the book, and we should have liked to have heard his opinion—that of the greatest authority living for such matters—on Major Ross's new methods of testing; the aluminium plate as a support; use of boric and phosphoric acids as reagents, &c. . . . We are glad to see that he advises that the fused boric acid should be kept in fragments and not in powder, as was formerly recommended. We look forward anxiously to the completion of the work, when perhaps some remarks will be made on Major Ross's methods of assaying, both qualitatively and quantitatively."

I feel indebted to the reviewer for his evident kind wishes towards me and my work, but fear he will be disappointed in his hopes regarding us. It would be too much to expect notice of any kind in Plattner with reference to an almost entirely new mode of analysis. Each must stand on its own ground in the future.

* *Zoisite* paste thus gives a yellow flame, *Tourmaline* a green one.

† Since this article was in type Dr. Richter has written to me, kindly promising to send me a copy of his work when completed.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 1st, 1877.

Professor Abel, F.R.S., President, in the Chair.

After the visitors had been announced and the minutes of the previous meeting read and confirmed, the names of Messrs. J. R. Young, S. S. Bell, W. Watson, and F. W. Toms were read for the first time. Messrs. Edward Hunter, Frederick Charles Cresswell Hewett, William Terrill, Alexander Kinninmont, John Borland, W. Handsel Griffiths, and George A. C. Pearce were ballotted for and duly elected Fellows after their names had been read the third time.

The President then read the list of officers and other members of council proposed for election at the Anniversary Meeting, and announced that there would be a Special General Meeting held afterwards, to take into consideration the proposals of the Council relative to alterations in the bye-laws regarding Associates, and on the form of obligation to be signed by Fellows on admission.

The Secretary also gave notice that those Fellows who wished to be present at the Chemical Society's Dinner at Willis's Rooms, on March 20th, should at once send in their names to Mr. Hall, at Burlington House.

The President then called on Prof. Thorpe to give his lecture "*On the Theory of the Bunsen Lamp*." The

speaker, after some preliminary remarks as to the great value of this lamp, both to the scientific chemist and in the Arts, pointed out the origin of it at the time when Bunsen introduced coal-gas into his laboratory: he considered the contrivances which had been used in this country as unworthy of the fuel they had to burn, and, bringing his own inventive powers to bear on the subject, the Bunsen lamp was the result; the original apparatus differing but little from that now generally in use. After a short description of the lamp, the mode by which the air is drawn in at the holes at the bottom, and caused to mix with the gas, was considered. This is due to the well-known fact that when a gas issues from an orifice under pressure it carries with it more or less of the circumjacent air, partly as the result of the expansion, and partly as the result of its viscosity. This was experimentally illustrated by an ingenious adaptation of List's multiplying manometer, which, when connected with one of the holes at the base of a Bunsen lamp, distinctly showed the rarefaction produced by the gas as it issued from the jet, despite its low pressure. The intermixture of the gas and air in the tube is greatly facilitated by the spreading out of the gas-stream after leaving the jet, and the amount of air carried in varies of course with the size of the air-holes, being in an ordinary burner from 2 to $2\frac{1}{2}$ times that of the gas. An average lamp, giving a flame 120 m.m. high, burns about 80 litres of gas per hour, so that as much as 250 litres of mixed gases pass through the tube of the lamp in that period of time. In some modifications of the lamp, such as Wallace's, the proportion of air is very largely increased, but then it is necessary to resort to some such contrivance as a perforated cap to prevent the flame retreating down the tube and burning below; for from Mallard's observations on the maximum rapidity of the propagation of combustion, it is evident that the velocity of the current of mixed gases in the tube of the Bunsen lamp would have to exceed that of the velocity of the propagation of combustion, in order that the flame should not retreat down the tube. Having traced the progress of the mixture of air and gas up the tube, attention was directed to the flame itself, which is hollow, and contains a large internal area of the uninflamed mixture, as it has been found that a mixture of gas with less than 3 times its volume of air will not burn; it is only, therefore, when it meets with an additional supply of oxygen from the surrounding air that combustion occurs. The composition of the gas in the uninflamed interior cone is not the same in every part, however, as has been shown by Blackmann, the amount of hydrogen, of the hydrocarbons, and of oxygen diminishing, and that of the carbonic oxide, carbonic acid, and especially the aqueous vapour and nitrogen, being largely increased, the latter being derived from the surrounding air. This was still more clearly shown in a table giving the amount of air mixed with 100 vols. of gas, both in the tube and at various distances above it. The cause of the rapid diminution in the proportion of hydrogen, and the corresponding increase in aqueous vapour, is to be sought for in the greater diffusive power of the gas, and the lower ignition point of a mixture of hydrogen with air. If the supply of air be cut off from the air-holes at the bottom of the Bunsen lamp, the flame becomes luminous, so that the non-luminosity of the flame is due to the air, and at first sight it would be imagined that it was due chiefly, if not entirely, to the oxygen in the air, since it is known that an admixture of air with coal-gas greatly decreases its luminosity; the nitrogen, however, is concerned in the matter, for if, instead of supplying air at the holes at the bottom of the lamp, we supply nitrogen, or even steam, the flame at once ceases to be luminous, showing that the oxygen of the air is not necessarily the true cause. Knapp has shown that any indifferent gas, as carbon dioxide or hydrochloric acid, will produce the same result. Frankland proved many years ago that a mixture of marsh gas and air, which was almost destitute of illuminating power, might be made to give a luminous flame by heating the gas to redness, and Wibel has recently shown that the ordinary Bunsen flame is luminous when the gas is previously heated. This fact was experimentally illustrated by means of a Bunsen lamp with a platinum tube: when the latter was heated to redness by means of a blowpipe, the flame became luminous, as when the air supply is cut off from the holes at the base. The feeble luminosity of the Bunsen flame would appear to be due to a variety of causes, such as the oxidation of luminiferous material, the action of the nitrogen and other diluting gases, and the withdrawal of heat by the indifferent gases, such as nitrogen, carbon dioxide, and water vapour, for, although the temperature of a flame of coal-gas mixed with air is higher than that of one of unmixed coal-gas, it requires a still higher temperature in order to become luminous. When the gas is lowered in the Bunsen lamp, and the flame becomes very small, it will be seen that it does not rest immediately upon the end of the tube—a fact due to two causes, namely, the cooling action of the tube, and to the velocity of ignition of the mixed gases being less than the rate at which they issue. When the flame is very small, we all know that the least current of air causes the flame to retreat down the tube and ignite the gas at the jet below; this is due to an admixture of air causing the velocity of ignition of the mixed gases to become greater than the rate at which it passes upwards in the tube. When the flame burns at the bottom a very much smaller quantity of air passes into the tube, and the gas which issues at the top is entirely deprived of oxygen, and has, moreover, a disagreeable odour arising in part from the presence of acetylene formed by the imperfect combustion of some of the hydrocarbons present; the amount of carbon monoxide also is very largely increased. The pernicious effect of this partially burned gas is due to the acetylene and carbon monoxide thus formed.

The PRESIDENT, in thanking the lecturer, remarked that it would have been difficult to select a subject having a more special interest for working-chemists; he had brought before them facts with which many were only generally or very partially acquainted, and made them familiar by his explanations and admirable experimental illustrations. Of those points of interest in the theory of the Bunsen lamp which had been mentioned, perhaps those bearing on the luminosity of flames were of the greatest interest at the present time, when so much attention was being directed to the subject.

Dr. FRANKLAND said that, although he had not paid any special attention to the luminosity of the Bunsen flame, it had been a point of special interest to him to ascertain the cause of the greater or less luminosity of flames under certain conditions. With regard to the effect of dilution on the luminosity of the Bunsen flame it had been advanced that when gases containing oxygen had been employed, such as carbonic anhydride, they had given up their oxygen, but there could be no doubt that this was not the case when nitrogen was used. From his own experiments it was evident that a comparatively slight elevation of temperature has a great effect on the luminosity of a flame which was just on the point of becoming luminous. He had resumed his researches on the luminosity of flames, and might say that he had repeated the very important experiments of Heumann, whose details of results he had found to be most accurate. He might mention that the exceedingly luminous flame of phosphuretted hydrogen did not give the faintest shadow in bright sunlight, showing that no solid matter was present in it; but as to whether the luminosity of carbonaceous flames was due merely to the great density of the hydrocarbon vapours, or to solid particles of carbon, was a matter which must still be considered as *sub judice*. The two important points to be determined were the presence or absence of polarised light in carbonaceous flames, and as to whether a flame whose luminosity was undoubtedly due to the presence of solid particles would behave in the same way under diminished pressure as hydrocarbon flames, such as that of a candle, &c.

Mr. Vernon Harcourt wished to ask the lecturer whether the luminosity of the Bunsen flame, when the tube was heated to redness, might not be due in part to the formation of tarry matters or of hydrocarbons containing a large proportion of carbon, as it was not possible that the mixture of gas and air could be passed through the red-hot tube without undergoing considerable change.

Dr. Wright suggested that the effect of heating the tube was comparable with that produced by lighting the jet below.

Prof. Thorpe replied that Heumann had very carefully examined into the matter, and had found that when the experiment was properly performed there was no deposit of tarry or carbonaceous matter in the tube. If a much longer platinum tube to the Bunsen were employed, and only the lower part heated so that the gases became cooled again before being burnt, the lamp gave a non-luminous flame, showing that the luminosity was chiefly due to the heating. In reply to a question put by Prof. Foster, he said that when a cold body was introduced into the luminous flame soot was deposited on it.

The President, after a formal vote of thanks to the Lecturer, adjourned the meeting until Thursday, March 15, when the following communications will be read:—(1) "Note on a Method for Estimating Bismuth Volumetrically," by Mr. M. M. P. Muir; (2) "Note on Gardenin," by Dr. J. Stenhouse and Mr. C. E. Groves; (3) "Preparation of Copper-Zinc Couples," by Dr. J. H. Gladstone and Mr. A. Tribe; (4) "On Chromium Pig-iron," by Mr. E. Riley.

PHYSICAL SOCIETY.

March 3rd, 1877.

Professor G. C. Foster, F.R.S., President, in the Chair.

The following were elected Members of the Society:—Mr. J. A. Fleming, Mr. P. le Neve Foster, and Mr. S. Hall.

Prof. Foster showed experimentally the polarisation of heat-rays, employing the large Nicol's prisms of 2⅝ inch aperture, and a thermopile surrounded by a double jacket and connected with a Thomson galvanometer, as arranged by Mr. Latimer Clark for showing very slight indications to an audience. When the principal sections of the prisms were at 90° to each other, only a slight movement—doubtless due to an initial heating of one side of the pile—was observed; and the amount of the deflection was found to increase steadily up to about 60 divisions on the scale as the above angle was diminished. Prof. Foster exhibited the results of experiments made to determine the intensity of a source of heat by this means, and they were very concordant.

Mr. Latimer Clark then explained the arrangement of the galvanometer used. The image of an arrow-head, or other form of index, projected by means of a lime-light at the further end of the room, traverses a telescopic object-glass about 2 ft. distant from the lamp, and falls on a square silvered plate of glass suspended from the needle of a Thomson galvanometer, which is rendered steady in the ordinary way by a platinum spade in water. The reflected image then traverses the whole length of the room, and falls on a large scale placed in front of the audience, and, by such an arrangement, the instrument may be at any distance from the scale and yet the image will not be unduly magnified. A method is employed for bringing the needle rapidly to rest. A few thermo-electric couples are placed above the lamp-chimney, thus being kept constantly hot, and the terminals are united by a wire which is coiled several times round the galvanometer; the circuit is completed at the moment when this subsidiary current will tend to neutralise the motion of the needle.

Prof. Guthrie incidentally mentioned that the difficulty experienced in separating the fibres of a cocoon-thread may be obviated by boiling the thread in carbonate of potash, when the natural resin is saponified and the fibres may be easily split.

Mr. Wilson then explained some difficulties he has met with in constructing a Holtz electrical machine, especially with reference to the windows and armatures; and he exhibited two machines which he recently made, from one of which a spark 5 or 6 inches in length can be obtained: this apparatus is so arranged that it can be taken entirely to pieces and packed in a very moderate-sized case. After carefully pointing out the difference between an ordinary machine and the Birch machine, he proceeded to consider the theory of the Holtz machine, and explained how he was led to construct an instrument in which there were no windows, the armatures being placed on the face of the fixed plate next to the moving plate, but the result was not satisfactory. He then made the larger machine provided with six fixed and six moving plates, and the windows were replaced by holes ⅛th inch in diameter, traversed by short pieces of tape glued to the paper armatures. The initial charging of the armatures is effected by means of a disk of ebonite fixed to the main axis of the machine, which is lightly held by the fingers and caused to rotate. Electricity is thus generated, and points projecting towards it and communicating with points in the neighbourhood of the armature cause them to become charged; after this electricity is generated with great rapidity.

Prof. McLeod gave some details concerning the working of a large Holtz machine which he drives by a turbine. He finds that after it has been in action for nearly an hour a much greater force is required to work it, and he suggested a theory in explanation of this phenomenon. By keeping the machine dry, under a glass shade, reversing effects are entirely avoided, as well as the necessity for varnishing the plates.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 6, 1877.

E. W. Binney, F.R.S., F.G.S., President, in the Chair.

"*On the Powerful Oxidising Action of Animal Charcoal upon Organic Matters as shown by the Analysis of the Drainage from a Large Heap of a Mixture of Night-soil and Animal Charcoal*," by William Thomson, F.R.S.E.

I had occasion some time ago to examine a sample of the fluid which had drained from a large heap of several thousands of tons of a mixture of night-soil and animal charcoal, which had lain for about one year or more, covered over with clay and pitch to prevent the rain from washing it away. This heap was about 7 or 8 feet in height, and the drainage from the whole which could be collected, did not amount to more than an average of about 12 gallons in 24 hours. It exuded from the heap in minute streamlets which drained down its sides, and at no part of this immense collection of oxidising organic matter could the slightest unpleasant odour be detected. The liquid which drained away was mixed with a small amount of suspended matter, which, however, soon settled to the bottom, leaving a perfectly colourless solution which was quite free from smell, but possessed a strong saline taste, and when treated with hydrochloric, sulphuric, or other acid it produced a copious effervescence.

This liquid was submitted to a very careful analysis in the following manner:—

1. 50 c.c. of the liquid was evaporated to dryness in a tared platinum capsule and heated in an air-bath at 220° F. till it ceased to lose weight, and its weight then noted.

2. This residue was then heated for some time to

redness to destroy and free it from any organic bodies and again weighed.

3. The remaining mineral matters were then submitted to analysis by separation of the different salts by means of alcohol of different strengths to corroborate the results of the more exhaustive analysis.

4. 5 c.c. of the solution were mixed with 245 c.c. of pure water, free from ammonia, distilled, and the free ammonia determined by means of "nesslerising" to show the proportion of ammonia in combination with carbonic acid. Pure carbonate of soda solution and pure water were added to the liquid remaining in the retort, and it was again distilled till the distillate ceased to show any colouration by the nessler test, and the ammonia from this distillate estimated by nesslerising. This operation would give the proportion of ammonia, which, although in the analysis of potable water would be termed "free ammonia," would in this case be in combination with hydrochloric acid. More pure water and permanganate of potassium were added to the solution, again remaining in the retort, and the liquid again boiled and the distillate collected with the same precautions as before, and the ammonia contained in it estimated. This should give an approximate idea of the nitrogen which is contained in the water, not as ammonia, but presumably in combination in some organic compound.

5. 100 c.c. of the sample were heated with a little free sulphuric acid, and a standard solution of potassium permanganate added till the liquid ceased to decolourise it, to find the amount of oxygen required to oxidise any matters capable of oxidation by such means.

The following determinations were made in the original water:—

Chlorine.—This was estimated by standard nitrate of silver solution.

Sulphuric Acid was determined by the usual gravimetric process.

Potash was weighed as potassium plato-chloride, the platinum being added after the sulphuric acid had been separated by baryta water, the baryta with milk of lime, and the lime with ammonium carbonate and a little oxalate

Magnesia was determined and weighed as magnesium pyrophosphate.

The free carbonic dioxide and that in combination with ammonia were estimated together by boiling 200 c.c. of the water in a flask and passing the distillate through a refrigerated apparatus and directly into a solution of barium chloride and ammonia, the resulting precipitate of barium carbonate was washed, dried, gently ignited, and weighed.

The *total quantity* of carbonic acid in the water was determined by treating 50 c.c. of the sample with an ammonia solution of barium chloride, and drying the resulting precipitate of barium sulphate and carbonate, placing it in a carbonic acid apparatus, and expelling the carbonic dioxide by means of sulphuric acid, and determining its amount by loss.

I may say that each result herein given was repeated two, three, or more times, so as to leave little or no doubt as to its accuracy.

The table below gives the results of this analysis.

The water contained a large proportion of sodium salts. This base, however, was not estimated directly, the excess of acids being calculated as having been combined with that base.

	Grains.			Grs. per Gal.
1. Solid matter left on evaporating 4000 grs. of the sample to dryness and *heating* at 220° F. till the residue ceased to lose weight	111·972	=	Total solid matter	1959·510
2. Weight of residue after prolonged heating to redness	111·898	=	Loss on ignition	1·295
	Grammes.			
3. Loss by treating the precipitate of barium sulphate and carbonate produced from 50 c.c. of the sample, with sulphuric acid and water in carbonic acid apparatus	0·2655	=	Total carbonic dioxide	371·700
4. Weight of the gently-ignited precipitate of barium carbonate produced from the distillation of 200 c.c. of the sample	2·7612	=	Carbonic dioxide, free, and in combination with ammonia	215·995
5. Ammonia (NH_3) obtained by distilling 5 c.c. of the sample with 245 c.c. of pure water and "nesslerising"	0·00575	=	Ammonia in combination with carbonic dioxide	80·500
6. Ammonia (NH_3) by distilling the liquid left in the retort from No. 5 with sodium carbonate and "nesslerising"	0·00010	=	Ammonia presumably in combination with hydrochloric acid	1·400
7. Ammonia (NH_3) obtained by distilling the liquid left in the retort from No. 6 with potassium permanganate and "nesslerising"	0·0000325	=	Nitrogen, presumably in combination in some organic compound	0·374
Weight of ignited precipitate of magnesium pyrophosphate from 50 c.c. of the sample	0·0928	=	Magnesium	27·964
Weight of dried precipitate of potassium plato-chloride from 25 c.c. of the sample	1·2053	=	Potassium	539·840
Weight of ignited precipitate of barium sulphate from 50 c.c. of the sample	1·3286	=	Sulphuric anhydride	638·640
50 c.c. of the sample required 27·2 c.c. of standard silver nitrate solution (each c.c. of st. solution is precipitated by 0·006306 grms. pure sodium chloride) = weight of sodium chloride	0·17152	=	Chlorine	145·719
100 c.c. of the sample required 9 c.c. standard potassium permanganate solution. Each grm. of oxalic acid required 550 c.c. of the st. solution to oxidise it = weight of oxalic acid	0·01636	=	Oxygen required to oxidise matters existing in the sample	1·454
			Nitrates and nitrites	Absent

A series of experiments were made as follows to decide how these bases and acids were combined :—

1. Saturated solutions of pure ammonium chloride and potassium sulphate were prepared and mixed together, an excess of the chloride in each experiment being used. Alcohol was then added, and the resulting precipitate of sulphate washed with alcohol till free from chlorides.

2. Saturated solutions of pure ammonium sulphate and potassium chloride were mixed together, and the resulting sulphate precipitates freed from chlorides, as above mentioned. The sulphate in each of the two above-mentioned cases was found to be *potassium sulphate*.

3. The same experiments were made with sodium chloride and potassium sulphate on the one hand, and sodium sulphate and potassium chloride on the other, and the resulting sulphate in both cases found to be *potassium sulphate*.

4. The same experiments were made with ammonium sulphate and sodium chloride on the one hand, and ammonium chloride and sodium sulphate on the other. The resulting sulphate in both cases being *sodium sulphate*.

5. The same experiment was made with sodium carbonate and potassium sulphate on the one hand, and sodium sulphate and potassium carbonate on the other. The resulting sulphate in both cases being *potassium sulphate*

Part of the magnesium carbonate being precipitated by boiling some of the liquid under examination, left no doubt as to the form in which it existed in the solution.

From these data I have arranged the analysis of the sample of drainage liquid as follows :—

	Grains per Gallon.
Total solid matter	1959·510
Organic matter, combined water, &c.	1·295
Fixed saline matter	1958·215
The fixed saline matter is composed of—	
Magnesium carbonate	97·874
Sodium carbonate	251·598
Potassium sulphate	1202·559
Sodium sulphate	153·566
Sodium chloride	235·311
Nitrates and nitrites	Absent
Loss	17·307
	1958·215

The following gives the proportions of free carbonic dioxide and volatile saline manners :—

	Grains per Gallon.
Free carbonic dioxide	17·110
Ammonium sesqui-carbonate	279·380
Ammonium chloride	4·406
Nitrogen, presumably existing in combination in some organic compound	0·370
Oxygen required by potassium permanganate test	1·454

There are many remarkable points about this drainage water.

First.—Although it comes directly filtering from what originally was most noxious organic matter, it is undoubtedly free from any of those substances, of which albumen may be taken as a type.

Second.—That all these organic matters have been practically completely decomposed by oxidation into carbonic acid, water, and ammonia, and the drainage remains charged with enormous quantities of these products. An idea of the quantity of carbonic dioxide present may be had by saying that 100 c.c. of the water contains 268·54 c.c. of this gas when measured at 0° C. and under a pressure of 760 m.m. of mercury.

Third.—That, although the oxidation of the organic matter had been so complete, yet the water was free from any trace of nitrates or nitrites.

Fourth.—That the water was free from any trace of lime or phosphoric acid, but contained a comparatively large proportion of magnesium carbonate, which was kept in solution by the ammonium salts and free carbonic acid; the presence of this magnesium salt would no doubt account for the absence of phosphoric acid.

Fifth.—The sediment and solution are practically free from bacteria or other animalculæ.

Sixth.—That when the residue from a large proportion of the water is heated to redness it produces no charring or smell.

It might be interesting here to compare a few of the results of this analysis with those from a water which I collected about the same time which drained during a heavy rain from decomposing animal matter, principally butchers' offal, which had not been treated with charcoal. It contained—

Drainage from Animal Matter without Charcoal.

	Grains per Gallon.
Total solid matter left on evaporating to dryness and heating at 220° F. till it ceased to lose weight	272·335
Matter lost by prolonged heating to redness	118·475
Saline matter	153·860
Free ammonia	15·447
Chlorine	13·394
Oxygen required by potassium permanganate test	85·629

When the dry residue was heated to redness it emitted a very bad smell at first, and afterwards the smell of burning hair.

Microscopic examination showed abundance of animalculæ swimming about in all directions.

The charcoal with which the night-soil had been mixed deserves some notice. It was that produced in the manufacture of prussiate of potash by the charring of animal refuse, such as hoofs, hair, leather, woollen rags, &c., so that, although it is really "animal charcoal," it differs very much from the substance usually known under that name, viz., that obtained by heating bones to a red heat in closed vessels. It appears to have a powerful effect in absorbing and oxidising noxious gases, probably greater than any other species of charcoal. I have read an interesting lecture, given by Dr. Stenhouse, of London, many years ago, which was kindly placed in my hands by our worthy President, Mr. Binney. He made some experiments to decide the value of different charcoals, and came to the conclusion that animal, more properly speaking bone charcoal, was best adapted for absorbing colour from liquids, but wood charcoal was best adapted for absorbing noxious gases; he, however, draws a distinct line between the capabilities of a charcoal to simply absorb, on the one hand, and to absorb and then oxidise or decompose noxious gases on the other; but he does not mention the results of any experiments made with the charcoal under consideration. The following analysis of this substance was made and given to me by Mr. Spiegel, of Oldham :—

	Per cent.	
Water	30·510	
Organic and volatile matters	4·520	*
Carbon	22·790	*
Sand and insoluble matter	16·300	
Oxide of iron and alumina	12·660	
Lime	2·110	
Magnesia	0·500	
Sulphuric acid	5·330	
Potash	3·117	
Soda	0·759	
Ferrocyanic acid	0·315†	
Traces of phosphoric acid, carbonic acid, and loss	1·059	
	100·000	

* Containing nitrogen = ammonia 1·035
† Existing as Prussian blue.

In conclusion I have to thank Mr. Ralph Clifton, of Stockport, for the care and manipulative skill which he has shown in making the analysis of the sample of drainage water.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

February 26th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

PROF. C. LIEBERMANN and F. SCHWARZER described some "*Additive Compounds derived from Anthracen and the Halogens.*" These additive compounds crystallise well, and are colourless, while the substituted halogen derivatives are coloured. Dichloro-anthracen-dibromide, $C_{14}H_8Cl_2Br_2$, crystallises in long needles, and yields upon heating hydrobromic acid, dichloro-bromo-anthracen, $C_{14}H_7Cl_2Br$, and dichloro-dibromo-anthracen, —

$$C_{14}H_6Cl_2Br_2.$$

Dichloro-anthracen-dichloride, $C_{14}H_8Cl_2Cl_2$, is obtained by leading chlorine through a solution of anthracen in chloroform. The colourless crystals possess strong doubly refractive properties, and easily decompose with the formation of HCl. By melting fine crystals of trichloro-anthracen, $C_{14}H_7Cl_3$, are obtained. Treatment with alcoholic potash does not yield KCl and $C_{14}H_7Cl_3$, as might be expected, but changes the compound quantitatively into anthraquinon.

Dr. BIEDERMANN remarked that in the course of recent experiments he had been unable to obtain similar crystalline addition compounds from phenanthen.

F. TIEMANN aad B. MENDELSOHN described some "*Derivatives of Vanillic Acid*" isomeric with the acids obtained from narcotin by oxidation. Aldehydo-vanillic acid, $C_6H_2(COOH)(OCH_3)(OH)(COH)$, was changed by treatment with CH_3I into—

$$C_6H_2(COOH)(OCH_3)(OCH_3)(COH),$$

isomeric with opianic acid, and this body by oxidation into—

$$C_6H_2(COOH)(OCH_3)(OCH_3)(COOH),$$

isomeric with hemipinic acid. The new isopianic acid differs from opianic acid (melting-point 140°) in melting at 208°, yielding the peculiar reactions of derivatives of salicylic acid, and not producing meconin by oxidation. The iso-hemipinic acid melts at 246°, 66° above hemipinic acid. This difference in the isomers prepared synthetically from vanillic acid and those obtained from narcotin is in full harmony with the researches of Beckett and Wright (*Journ. Chem. Soc.*, March, 1876) upon the structure of opianic acid and hemipinic acid, as well as with those of the authors upon the structure of vanillic acid. They regard the arrangement of the substituted groups, $COOH.OCH_3.OCH_3.COOH$—1, 3, 4, 5—as consistent with all the reactions of the new compounds.

W. KLOBUKOWSKI has obtained "*Penta-brom-azo-naphthalin*," $C_{20}H_6Br_5N_2$, by the action of bromine upon azo-naphthalin in the presence of iodine. Bromine alone produces easily decomposed compounds. The new compound is insoluble in most solvents, and is deposited upon sublimation in the form of orange-coloured needles, not melting under 320°. It is obtained also by heating azo-naphthalin with an excess of bromine at a temperature of 260°. The azo-naphthalin used was obtained by the distillation of nitro-naphthalin with zinc-dust. The author finds the best solvent for purposes of crystallisation to be glacial acetic acid containing a few drops of fuming nitric acid. Experiments upon azo-naphthalin with fuming nitric acid alone, and in combination with sulphuric acid, gave no satisfactory results.

A. MICHAEL and S. GABRIEL describe a "*Phthalyl-Acetic Acid*" obtained by the action of acetic anhydride and anhydrous acetate of sodium upon phthalic anhydride. The reaction is as follows: —

$$C_6H_4(CO)_2O + (CH_3.CO)_2O = C_6H_4(CO)_2.CH.COOH + CH_3COOH.$$

The mixrure is heated together for nearly an hour, and then treated with warm water. The yellow crystals of the new acid, which separate out on cooling, are insoluble in pure water, easily crystallised from alcohol, and melt at 241°, under partial decomposition.

Prof. A. W. HOFMANN points out the existence of a series of "*Guanidin Sulpho-Acids*," the formation of which is analogous to that of the bases from which the guanidins are obtained. The reaction was particularly illustrated with diphenyl-guanidin. When this is submitted to the action of water or dilute acids the following decomposition takes place: —

$$C(C_6H_5)_2H_3N_3 + 2H_2O = CO_2 + 2C_6H_5NH_2 + NH_3.$$

In the presence of concentrated H_2SO_4 the aniline is converted at once into sulphanilic acid, $C_6H_4(HSO_3)NH_2$. By exposing the mixture of diphenyl-guanidin and H_2SO_4 to a moderate heat no CO_2 is evolved, and the guanidin disappears in the liquid, from which a new sulpho.acid. $C(C_6H_4SO_3H)_2H_3N_3$, is obtained. The Ba, Pb, and Ag salts were described. Other guanidins were found to exhibit a perfectly analogous deportment. Experiments have been especially made with triphenyl-guanidin and the base obtained by the action of CCl_4 upon aniline.

In a late communication to the Society (CHEM. NEWS, vol. xxxv., p. 85) A. Kern stated that monomethyl-aniline was not formed by the action of CH_3I on $C_6H_5NH_2$, and doubted the existence of the compound on strength of his experiments. Prof. Hofmann read in this connection a paper from P. HEPP, "*On Mono-methyl Aniline*," which he has obtained by submitting the sodium derivative of acetanilid to the action of iodide of methyl. The compound thus prepared possesses exactly the same properties (boiling at 192°, &c.) which Prof. Hofmann has observed in mono-methyl aniline separated in large quantities from commercial aniline by the action of chloride of acetyl.

The following communications have been received from non-resident members:—

V. MEYER, "*On the Molecular Constitution of Ammonium Chloride.*" A. Ladenburg has recently defended the theory of the trivalence of nitrogen, and the correctness of the formula $NH_3.HCl$, by a comparison of the two bodies $N(C_2H_5)_3C_7H_7I$ and $NC_7H_7(C_2H_5)_2C_2H_5I$, obtained respectively from triethylamin with benzyl-iodide, and benzyl-diethyl amine with ethyl-iodide. These two bodies he regarded as essentially different, the first by treatment with HI yielding C_7H_7I; the latter, not Meyer, has repeated the experiments, and found the two bodies to be identical. The separation of C_7H_7I, in the one case, he considers to be due to the presence of small portions of $(C_7H_7)_2(C_2H_5)_2NI$, which is always formed in the process, and loses benzyl iodide easily; and he regards the two bodies as additional proofs for the formula NH_4Cl of the typical ammonium chloride.

A. BEHR has examined "*The Organic Acids present in the Juice of the Sugar-Cane.*" In addition to malic acid and oxalic acid, the only two acids previously detected, he has found aconitic acid, forming 0·149 per cent of the crude melago sugar obtained by simply boiling the juice of the sugar-cane. It is separated out in a pure state by treatment with acetate of lead and H_2S, followed by repeated crystallisations in the form of the ammonium salt. The turbidity of the aqueous solution of melago sugar was found to be due to the presence of aconate of lime, and simply by treatment with water large quantities of the acid can be obtained. Aconitic acid, $C_6H_6O_6$, appears to bear the same relation to the juice of the sugar-cane that citric acid—also a hexacarbon acid—does to the juice of the sugar-beet. The melting-point of the author's acid being 172°, and that given in chemical works being 140°, he was led to investigate this subject, and found the

melting-point of aconitic acid various, according to the method of preparation, but that in all cases it lies near 170°.

A. Christomanos, "*On Chromic Iron Ore.*" The formula of Rammelsberg, $R_3O_4 = FeO,Cr_2O_3$, has been found correct for most specimens occurring in Greece. Other proportions have, however, been found—$Cr_2O_3 : FeO$, 1 : 1, 1 : 2, 2 : 3, 3 : 2.

T. Haver Droeze contributes an extensive array of experiments "*On the Solubility of Gypsum in Water and Various Saline Solutions.*" The results obtained with water coincide more closely with those published by Marignac than with those of other observers. Gypsum is, in general, more soluble in saline solutions than in water. In a solution of $MgSO_4$ it is, however, completely insoluble.

O. N. Witt describes his discovery of the "*Chrysoidin*," lately investigated by A. W. Hofmann (Chemical News, vol. xxxv., p. 64).

R. Anschutz finds that by the "*Action of Acetyl-Chloride upon Dibasic Acids*," instead of mixed anhydrides, acetic acid and the anhydride of the acid used are formed.

R. Anschutz and G. Schultz, "*Action of Sodium Amalgam upon Phenanthren-quinon.*" By the action of hydrogen *in statu nascendi* on an alcoholic solution of phenanthren-quinon, reduction and oxidation take place at the same time, forming diphenyl-carbonic acid,—

$$COOH.C_6H_4-C_6H_4COOH.$$

H. Beckerts and R. Otto, "*A Simple Method of Preparing Propionic Acid from Propionitril.*" This consists in treating propionitril at 100° with three times its weight of a mixture of 3 vols. H_2SO_4 and 2 vols. H_2O. At the expiration of about two hours the reaction is ended, and the nitril changed almost quantitatively into propionic acid, which forms the upper layer of the liquid, and can easily be separated and purified. The method is preferable to that of treatment with HKO, &c., hitherto in use, on account of its rapidity, and it can be used for the production from their nitriles of such acids as cannot exist in an alkaline liquid.

"*On Solid Dichloro-propionitril.*" The authors have previously expressed the opinion that the solid dichloro-propionitril formed contemporaneously with the liquid α-dichloro-propionitril by the action of chlorine upon propionitril is a polymeric modification of the α compound. This assumption is supported by two experiments. If the solid dichloro-propionitril is heated with dilute H_2SO_4 it changes almost entirely into the liquid form. The proportion of the solid compound obtained in the joint preparation of the two is heightened by decreasing the temperature.

"*On the Preparation of Monochloracrylic Acid and Pyro-racemic Acid from α-Dichloro-propionic Acid.*" The silver salt of the latter yields, upon heating with water, a solution of monochloracrylic acid,—

$$C_3H_3Cl_2AgO_2 = C_3H_3ClO_2 + AgCl,$$

If Ag_2O or Ag_2CO_3 be added to this solution in the proportion of ½ mol. to 1 mol. of the acid silver monochloracrylate is formed, and this upon heating yields pyro-racemic acid, $C_3H_2ClAgO_2 + H_2O = AgCl + C_3H_4O_3$. This acid is also obtained directly from α-dichloro-propionic acid, $C_3H_4Cl_2O_2 + Ag_2CO_3 = C_3H_4O_3 + 2AgCl + CO_2$.

C. Böttinger, "*On the Dry Distillation of Glycerinic Acid.*" Pyro-racemic acid is obtained in such very small quantities by this operation that the reaction cannot be used to explain the structural formula of the acid. A new acid, $C_4H_6O_3$, melting at 83°, and possessing striking crystalline properties, was found in small quantities in the distillate.

"*On Indigo.*" In the preparation of anthranilic acid from indigo formic acid was found to be the only other well characterised body yielded by the reaction, in accordance with the formula—

$$C_8H_5NO + O + 2H_2O = C_7H_5(NH_2)O_2 + CH_2O_2.$$

As this would tend to show that the eighth carbon atom in indigo is joined to hydrogen, the authors regard the reaction as being in favour of the following formula for indigo:—

$$C_6H\langle\begin{matrix}CO\\N\end{matrix}\rangle CH.$$

Ortho-amido-benzoic aldehyd and formic acid,—

$$C_6H_4(NH_2)(COH) \text{ and } CH_2O_2,$$

could then be regarded as the most probable generators of indigo.

F. Beilstein and A. Kurbatow, "*On the Chlorine Derivatives of Benzene.*" The authors have succeeded in obtaining the third isomeric trichloro-benzene, and the third isomeric tetrachloro-benzene wanting to complete the list of all possible chlorine derivatives of benzene according to the theory of Kekulé. Trichloro-benzene (1, 2, 3) is obtained by the action of ethyl-nitrite on p-m-o-trichlor-aniline (melting-point 67·5°). It crystallises in large laminæ from alcohol, melts at 54°, and boils at 219°. The nitro-derivative, $C_6H_2Cl_3NO_2$ (1, 2, 3, 4), crystallises in lustrous needles, melts at 56°, and yields by reduction the original trichloraniline. Tetrachloro-benzene (1, 2, 3, 4) is obtained from the above-mentioned trichloraniline by replacing the amido group by a chlorine atom. It crystallises in needles, melts at 46°, and boils at 245° to 253°. The nitro-compound is changed by reduction into tetrachlor-aniline, melting at 118°.

J. Stenhouse and C. E. Groves, "*On Dinitroso-orcin and Dinitro-orcin,*" (See Chem. News, vol. xxxv., p. 35.)

A. Fitz describes an extensive series of experiments "*On Schizomycetic Fermentation.*" A trace of this ferment causes in dilute aqueous solutions of glycerin, in the presence of $CaCO_3$ at 40°, a vigorous fermentation, producing chiefly, besides CO_2 and H_2O, ethyl-alcohol, normal butyl-alcohol, normal butyric acid, and caproic acid. Sulphate and phosphate of ammonia were found to give good results as sources of nitrogenous nourishment. By use of pepsin for this purpose a volatile base of the picolin series was obtained in small quantities. Mannite yields by the same fermentation normal butyl alcohol, normal butyric acid, and small quantities of succinic acid. Dextrin and starch yield with this process small quantities of alcohol.

CORRESPONDENCE.

CHEMICAL ANALYSIS FOR THE LOCAL GOVERNMENT BOARD.

To the Editor of the Chemical News.

Sir,—The Local Government Board has recently communicated to the Town Clerk of a northern town that when it engages a chemist to make an analysis of water it pays him three guineas for the analysis; the analyses concerning which this communication was made being of a very elaborate kind, viz., complete analyses of the mineral matter in the water, in addition to the routine work—such analyses as chemists usually charge ten guineas for.

I trouble you with this letter in order that chemists may be warned that, unless they exact their fees beforehand, they will run great risk of being defrauded by the Local Government Board of that to which they are justly entitled.—I am, &c.,

J. Alfred Wanklyn.

March 7, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 8, February 19, 1877.

Remarks by M. Chevreul in reference to a Paper on the Phosphorescence of Organic Bodies by M. B. Radziszewski.—The author calls attention to his

memoir "On the Simultaneous Action of Gaseous Oxygen and of Alkalies upon a Great Number of Organic Bodies," read before the Academy of Sciences August 23, 1824.

Manufacture of Carbon Conductors for the Electric Light.—M. F. Carré.—The author saturates charcoal with solutions of certain salts, and finds that potash and soda double the length of the electric arc, and augment the light in the proportion of 1 to 1·25. Lime, magnesia, and strontia increase the light to 1·30 to 1·50; iron and manganese to 1·60 to 1·70. Boracic acid increases the durability of the carbon, but does not improve the light. The saturation of pure regularly porous charcoal with the solutions of different bodies is a convenient and economical method of producing their spectra, but it is preferable to mix the simple bodies with compound carbons.

Detection and Determination of the Principal Colouring Matters employed in the Sophistication of Wines.—M. G. Chancel.—The author takes 10 c.c. of wine, and adds 3 c.c. of a dilute solution of subacetate of lead, allowing the mixture to subside for a few minutes to make sure that the precipitation is complete. If this is not the case a slight excess of the reagent is added. After stirring and heating for a few moments it is thrown on a very small filter, the filtrate collected in a test-tube, and the precipitate washed three or four times in hot water. If the filtrate is coloured magenta is present, and may be sought for by the aid of the spectroscope. But if the wine contains a mere trace of this colour it is retained in the precipitate, and is sought for in the manner directed below.

To discover the colouring matters which may be contained in the plumbic precipitate, it is treated upon the filter with a few c.c. of a solution of carbonate of potassa (2 parts of the dry salt to 100 of water), taking care to repass *the same solution* several times through the precipitate. Any magenta present is thus extracted, along with carminamic (ammoniacal cochineal) and sulphindigotic acid. The colouring matters of logwood and of alkanet remain undissolved. With a genuine wine the alkaline liquid takes a very faint yellow or greenish yellow tint. For the detection of magenta the filtrate is mixed with a few drops of acetic acid, and it is then shaken up with amylic alcohol. The magenta dissolves in this alcohol with a fine rose tint, and its presence is proved by spectroscopic examination. Carminamic and sulphindigotic acids remain in the aqueous solution, and are decanted off. A couple of drops of sulphuric acid are added, and the mixture is again shaken up with amylic alcohol, which now dissolves the ammoniacal cochineal. It may be detected by the spectroscope. The sulphindigotic acid remains undissolved in the amylic alcohol, and may be found in the blue aqueous residual liquor by means of the spectroscope. Logwood is most conveniently sought for in a fresh portion of the wine by digestion with a little precipitated carbonate of lime, adding a few drops of lime-water, and filtering. In a natural wine the filtrate has a faint greenish yellow colour, but if logwood is present it takes a fine red shade, and the absorption-bands of logwood may be detected with the spectroscope. On treating the lead precipitate above mentioned with an alkaline sulphide, washing with boiling water, and then treating with alcohol, in which alkanet, if present, is detected by spectroscopic examination.

Action of Alkaline Sulphocyanides on the Hydrochlorates of the Alkalies of the Fatty Series.—P. De Clermont.—The double decomposition between sulphocyanide and hydrochlorate of aniline determines a molecular change which gives rise to sulph-urea.

Action of Electrolytic Oxygen upon Glycol.—M. A. Renard.—Not suited for abstraction.

Localisation of Copper in the Organism after Ingestion of a Salt of this Metal.—M. Rabuteau.—In this case a woman in the course of 122 days had taken 43 grms. of ammoniacal sulphate of copper. Three months after the last dose she died of rapid tuberculosis. The liver, weighing 1474 grms., contained only 23·95 centigrms.

Buds of the Vine as a Material for Paper Making.—M. Boutin.—An industrial suggestion.

MEETINGS FOR THE WEEK.

Monday, 12th.—London Institution, 5.
—— Medical, 8.
—— London Institution, 5.
—— Society of Arts, 8. "Cantor Lectures. "Chemistry of Common Life," A. Vernon Harcourt, F.R.S.
Tuesday, 13th.—Royal Institution, 3. Prof. Garrod, "On the Human Foot: its Structure in Relation to its Contour."
—— Civil Engineers, 8.
—— Photographic, 8.
—— Society of Arts, 8. "Our Commercial Relations with West Africa, and their Effects upon Civilisation," by James Irvine.
Wednesday, 14th.—Society of Arts, 8. "The Treatment of Town Refuse and Sewage," Prof. Ansted, F.R.S.
Thursday, 15th.—Royal, 8.30.
—— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
—— Chemical, 8. "Note on a Method of Estimating Bismuth Volumetrically," by M. M. P. Muir. "Note on Gardenine," by Dr. Stenhouse and Mr. Groves. "Preparation of Copper-Zinc Couples," by Dr. Gladstone and Mr. Tribe. "On Chromium Pig-Iron," by E. Riley.
—— London Institution, 7.
—— Royal Society Club, 6.30.
—— Society of Arts, 8. (Indian Section). "The Native Indian Press," Dr. G. Birdwood, C.S.I.
Friday, 16th.—Royal Institution, 9. "Armenia and Ararat," Dr. J. Bryce.
Saturday, 17th.—Royal Institution, 3. Prof. H. Morley on "French Revolution and English Literature."
—— Physical, 3. "On some Points which have a Bearing on the Theory of the Photographic Image," by Capt. Abney, F.R.S. "On a Modification of Mance's Method of Measuring the Resistance of Batteries, &c.," by O. J. Lodge, B.Sc. "Certain Experiments with a large Induction Coil," by W. Spottiswoode, F.R.S.

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MANCHESTER CORPORATION GAS-WORKS.—TO TAR DISTILLERS AND OTHERS.—The Gas Committee are prepared to RECEIVE TENDERS for the Purchase of the Whole or Portion of the GAS-TAR to be produced at their Gaythorn and Rochdale Road Works for the term of one or more years, as may be agreed upon, commencing on the 1st day of March, 1878. The total quantity that will be produced during the first year is estimated at 15,000 tons or thereabouts. Sealed tenders, addressed to the Chairman of the Gas Committee, Town Hall, and endorsed "Tender for Gas-Tar," must be delivered at this office on or before the 20th day of March next. The Committee do not bind themselves to accept the highest or any tender.—Further particulars as to conditions of contract and forms of tender may be obtained on application to Mr. Jackson, at the Gas Office.—By order of the Gas Committee.

JOSEPH HERON, Town Clerk.

Gas Office, Town Hall, Manchester, 27th January, 1877.

THE CHEMICAL NEWS.

Vol. XXXV. No. 903.

ON THE ESTIMATION OF CHROMIUM IN CHROMATE OF IRON ($FeO.Cr_2O_3$).

By SERGIUS KERN, St. Petersburg.

Chromium compounds are much employed in the arts as pigments possessing bright colours. The chief ore from which chromium compounds are obtained is chrome ironstone or chromate of iron. This ore is analysed in nearly all cases by Dr. Clark's titration method, giving very accurate results. A quick method used by me for the estimation of chromium also gives good results, and may be thus described:—0·5 grm. of well-washed powdered mineral is fused with acid potassium sulphate ($KHSO_4$); the resulting mass is powdered and dissolved in nitric acid with the addition of a small quantity of potassium chlorate. The solution is filtered from the silica and other insoluble matter, and ammonium disulphide (NH_4HS) is next added in order to precipitate the iron in the form of sulphide, and the chromium in the form of hydrated chromium oxide. The precipitate is filtered from the liquor, dried, and ignited till all the fused mass shines with a bright white light. The resulting mass is powdered and dissolved in strong hydrochloric acid. The iron compound dissolves, leaving the anhydrous chromium oxide in the form of a precipitate, which is washed, dried, and weighed.

The following experiments were made in order to know the accuracy of this method:—

1. *Estimation of Chromium by Titration.*—0·5 grm. of iron chromate (No. I.) gave 0·320 grm. of Cr_2O_3, equal to 20·6 per cent of Cr; 0·5 grm. of iron chromate (No. II.) gave 0·200 grm. of Cr_2O_3, equal to 12·8 per cent of Cr; 0·5 grm. of iron chromate (No. III.) gave 0·080 grm. of Cr_2O_3, equal to 5·2 per cent of Cr.

2. *Estimation of Chromium by the Method Mentioned above.*—0·5 grm. of iron chromate (No. I.) gave 0·319 grm. of Cr_2O_3, equal to 20·5 per of Cr; 0·5 grm. of iron chromate (No. II.) gave 0·199 grm. of Cr_2O_3, equal to 12·8 per cent of Cr; 0·5 grm. of iron chromate (No. III.) gave 0·076 grm. of Cr_2O_3, equal to 4·89 per cent of Cr.

These experiments prove that in some cases the method proposed may be used in analysing the iron chromate.

Obouchoff Steel Works, St. Petersburg.

RESEARCHES ON THE SPECTRA OF METALS AT THE BASE OF FLAMES.

By M. GOUY.

It is known that a flame produced by a mixture of coal-gas and air in suitable proportions, so as to burn without the aid of the external air, has for a base an interior cone, on the surface of which combustion begins. This surface is brilliant, of a blue or green colour, and gives the spectrum of carbon. The experiments that I have to report show that this same surface gives a spectrum very different from that of the flame of which it forms the base, when the combustible mixture holds in suspension saline powders. The solutions are pulverised by a jet of compressed air; the air charged with spray enters a regulator, where also arrives coal-gas, and from whence issues a mixture of constant composition. This mixture enters a vertical tube, of 19 m.m. in diameter, capped with a gauze of iron-wire, above which it burns with a conical flame of from 6 to 8 c.m. The height of the interior cone varies from 3 or 4 c.m. to zero, and the flame may be rendered oxidising or reducing at pleasure.

By means of a lens we project on the slit of the spectroscope the image of the flame. We then see two spectra one above the other; the lower one is produced by the light of the blue surface, and all the rays which compose it are cut off exactly at the same height; the other is produced by the flame, properly speaking, and the rays which are peculiar to it encroach on the lower spectrum by reason of the form of this flame.

When the apparatus is worked empty, the lower spectrum shows brilliantly the rays of carbon. If a solution of chloride of lithium is pulverised, the following facts are observed:—The upper spectrum shows a red ray, very vivid, and a feeble ray in the orange. The first appears equally brilliant in all its height; the other, at the point where it penetrates into the lower spectrum, becomes more vivid. Besides, the lower spectrum shows clearly a blue ray (γ of the electric spectrum), which terminates at the same height as the rays of carbon, and is wanting in the upper spectrum. We find these characters with other metals:—

Sulphate of Thallium.—It gives its characteristic green ray, which is distinctly strengthened in penetrating the lower spectrum.

Chloride of Calcium.—The upper spectrum is deprived of the rays peculiar to the undecomposed chloride. The blue ray is strengthened a little in penetrating the second spectrum.

Chloride of Strontium.—The upper spectrum offers nothing in particular; the lower shows three faint blue rays, which belong to the electric spectrum of strontium.

Chloride of Barium.—The rays and bands of the upper spectrum are strengthened on penetrating the other, especially the brilliant green ray.

Chloride of Manganese.—The upper spectrum shows traces of the rays α and γ of the electric spectrum: this latter is more visible when the flame is oxidising. The lower spectrum gives brilliantly the ray α quite near to the green ray of carbon. This ray is triple in the electric spectrum; I have only been able to see one of its components, the other no doubt being confounded with the carbon ray. Of these two components, the most brilliant is as much so as the carbon ray; and, as it is very near, we may ascertain that they have exactly the same height. The ray γ is not strengthened in the lower spectrum.

Chloride of Iron.—The flame is very luminous, of a greenish yellow. The upper spectrum is formed by two bands and fine rays, very numerous, on a continuous ground. The lower spectrum shows three groups of rays, very visible, which correspond to the groups of the electric spectrum β and ζ between green and blue, and γ in the violet.

Chloride of Cobalt.—The flame much resembles the former. The upper spectrum is formed by a very bright continuous illumination; the lower shows three faint rays in the violet and the extreme violet, γ, θ, and η of the electric spectrum.

Chloride of Zinc.—Nothing but faint continuous illumination in the upper spectrum; the lower shows the violet ray α of the electric spectrum very distinct.

Chloride of Cadmium.—Nothing in the upper spectrum; the other gives a faint violet ray, β of the electric spectrum.

Nitrate of Manganese.—The upper spectrum has nothing in particular; the lower shows a group of three faint violet rays, α of the electric spectrum.

Nitrate of Copper.—The upper spectrum shows several bands; one of them, in the red, is notably strengthened in the lower spectrum.

Nitrate of Lead.—Nothing in the upper spectrum; the other gives a very visible ray in the extreme violet, α of the electric spectrum.

Nitrate of Silver.—Nothing in the upper spectrum; the other shows two very marked rays, α and β of the electric spectrum.

Chloride of Platinum.—The flame is of a bluish white; it illuminates as well as a candle. The upper spectrum

shows a vivid continuous light, with some faint bands and rays. The lower spectrum does not resemble the electric spectrum; it is formed by a beautiful series of very brilliant bands, fading away on the side of the red, and sharply defined at the other extremity; we also see some more faint rays.

Amongst the other metals some have not been submitted to the experiment, and others have not given very definite results.

The spectra which we have just been describing have been observed with flames slightly reducing. In charging the flame with gas the interior cone grows longer, and its spectrum becomes less brilliant without changing its nature. With a large excess of air the cone changes its form, and is divided into violet points, sometimes very high; at this moment the carbon rays disappear, except that of the violet; they are replaced by a continuous ground, upon which are detached faint metallic rays. The flame, properly speaking, is almost invisible, and shows hardly any trace of the sodium ray, but it becomes visible and is coloured green when it contains copper.

To sum up, we see that the base of the flame gives, at a very small height, a spectrum which approaches the electric spectrum of the same metal; I propose to extend these researches to other flames. I shall remark, in concluding, that in ordinary spectral analysis we see a mixture of the two spectra of the cone and the flame: the relative intensity of the rays must therefore change according to the part of the flame which we examine, as M. Lecoq de Boisbaudran had observed for chloride of manganese.—*Comptes Rendus.*

SCHEELE'S GREEN:
ITS COMPOSITION AS USUALLY PREPARED AND SOME EXPERIMENTS UPON ARSENITE OF COPPER.*

By S. P. SHARPLES, S.B.

(Concluded from p. 92)

Experiment No. 6.

	Molecules.
Copper sulphate	6
Sodic carbonate	3
Arsenic trioxide	1

The filtrate was blue and acid; the precipitate gave:—

ANALYSIS No. XI.

	Per cent.	Atomic Ratios.
Copper oxide	60·80	7·60
Arsenic trioxide	14·53	0·73
Sulphur trioxide	13·34	1·67
Water	11·11	6·17

This corresponds with a mixture of tribasic arsenite and sulphate, with a little excess of copper oxide.

To the blue filtrate from the above, three molecules more of sodic carbonate were added, the filtrate was faint yellow, and free from copper, but contained arsenic; the precipitate contained a little carbonate.

ANALYSIS No. XII.

	Per cents.	Atomic Ratios.
Copper oxide	56·71	7·14
Arsenic trioxide	28·62	1·44
Sulphur trioxide	1·59	0·20
Water	9·50	5·28
Carbon dioxide	3·35	0·77
	99·77	

These precipitates both dissolved in ammonia with a blue colour, and stood boiling without change of colour.

Experiment No. 7.

	Molecules.
Copper sulphate	6
Potassium carbonate	6
Arsenic trioxide	1

Boiled for half an hour, filtrate colourless, free from copper, but contained arsenic; precipitate did not blacken on boiling, was free from carbonates, but contained basic sulphate. Washed until filtrate was free from arsenic.

ANALYSIS No. XIII.

	Per cents.	Atomic Ratios.
Copper oxide	58·85	7·41
Arsenic trioxide	27·08	1·37
Sulphur trioxide	4·83	0·60
Water	8·55	4·75
	99·39	

Experiment No. 8.

Scheele's original receipt is very nearly one part by weight of arsenic to three each of copper sulphate and potassium carbonate, and is frequently so given. The proportions as given by Scheele are, 11 ounces of the first, and 32 of each of the others. In molecules, supposing the potassium carbonate to be pure and anhydrous, as he directs it should be, the receipt will be as follows:—

As_2O_3	1·00
CuO	2·32
K_2CO_3	4·34

Or nearly double the amount of potassium carbonate required in the reaction—

$$CuSO_4 + K_2CO_3 = CuCO_3 + K_2SO_4.$$

A portion was therefore prepared, using—

	Parts.	Molecules.
Copper sulphate	6	2·35
Potassium carbonate	3	2·17
Arsenic trioxide	2	1·00

The filtrate was slightly acid and blue, but the potassium carbonate used not quite anhydrous. The colour produced was fully equal to that produced by the ordinary receipt. The filtrate contained arsenic.

ANALYSIS No. XIV.

	Per cents.	Atomic Ratios.
Copper oxide	51·37	6·62
Arsenic trioxide	39·94	2·02
Sulphur trioxide	1·80	0·22
Water	6·61	3·67

This is almost an exact mixture of tribasic sulphate and arsenite. It dissolved in ammonia with a blue colour, and did not blacken on boiling. The potassium carbonate may, therefore, be considerably diminished from that called for in Scheele's receipt.

Experiment No. 9.

This was nearly a repetition of Experiment No. 4 as to quantities used. The object being in this case to study more fully the effects of washing, the proportions taken approximate closely to Scheele's receipt:—

	Parts.	Molecules.
Copper sulphate	3	2·35
Arsenic trioxide	1	1·00
Potassic carbonate	3	4·34

The solutions were mixed and boiled for half an hour; the first (No. XV.) was washed until the wash-water was free from sulphates; the other (No. XVI.) until the wash-water was free from arsenic.

ANALYSIS No. XV.

	Per cents.	Atomic Ratios.
Copper oxide	52·23	6·60
Arsenic trioxide	35·41	1·79
Sulphur trioxide	5·88	0·74
Water	6·02	3·35
	99·54	

ANALYSIS No. XVI.

	Per cents.	Atomic Ratios.
Copper oxide	57·18	7·20
Arsenic trioxide	25·62	1·30
Sulphur trioxide	6·31	0·79
Water	10·85	3·90

* Read before the American Academy of Arts and Sciences.

Experiment No. 10.

This preparation was made exactly according to Scheele's own directions, as given by himself in the *Proceedings of the Stockholm Academy*, using the English translation for the weights and measures. The sample was divided after precipitation. No. XVII. was washed by decantation with the amount of water he specifies.

No. XVIII. was first boiled with water, and then washed with hot water so long as arsenic was found in the filtrate. The proportions used were :—

	Parts.
Arsenic trioxide	11
Potassium carbonate	32

Dissolved the potassium carbonate in thirty-two parts of water, added the arsenic trioxide, boiled and filtered.

	Parts.
Copper sulphate crystallised ..	32
Water	192

Dissolved and boiled while hot; added, with constant stirring, the hot solution of arsenic trioxide.

ANALYSIS No. XVII.

	Per cents.	Atomic Ratios. Found.	Taken.
Copper oxide	50·76	3·10	2·32
Arsenic trioxide ..	40·82	1·00	1·00
Sulphur trioxide ..	1·63	0·10	—
Water	6·41	1·75	—
	99·62		

ANALYSIS No. XVIII.

	Per cents.	Atomic Ratios.
Copper oxide	49·25	6·20
Arsenic trioxide..	42·66	2·15
Sulphur trioxide	0·42	0·05
Water..	6·71	3·72
	99·04	

In summing up, I will first call attention to the fact that in no one of the eighteen samples does the arsenic exist in these compounds in as great a ratio as required by Bloxam's formula. Further, they all contain water, and this water is not driven off at a temperature of 150° C. In every case arsenic was found in the filtrate, sometimes in considerable amount, as is shown by comparison of the ratios of copper sulphate and arsenic trioxide taken, and the ratios between the copper oxide and arsenic, as found in the analysis. All the samples dissolved in ammonia with a blue colour.

In Experiments 4, 9, and 10 almost identical amounts of substances were taken; but the results, as will be seen, differ widely.

Scheele's green may, according to my experiments, be described as a more or less basic copper arsenite, which may or may not contain basic copper sulphate and carbonate; the composition of it seeming to depend to a considerable extent upon the degree of concentration of the liquid from which it is precipitated. Its basicity also seems to depend to a considerable extent upon the same fact, the more dilute the solution the more basic the salt.

The composition also depends, to some extent, on the amount of wash-water used in washing it.

The normal pigment which is represented by Analysis XVIII. may be described as follows:—

It is of a yellowish green colour, soluble in dilute acids and in caustic alkalies. It dissolves in alkalies with a blue colour, and is decomposed by excess of soda or potassa, or their carbonates, but is not decomposed by ammonia, even upon boiling. It does not blacken upon boiling with distilled water. When dissolved in ammonia, if a solution of soda or potash is added, the solution is bleached, from the reduction of the copper salt to a cuprous salt.

Its average composition, as generally prepared, omitting the sulphur trioxide which is generally found in it, is about as follows:—

Copper oxide	50·00
Arsenic trioxide	42·00
Water	8·00

This approximates closely to the formula—

$$Cu_3As_2O_6.2H_2O.$$

This formula would give the following percentages:—

Copper oxide	51·44
Arsenic trioxide	41·93
Water	7·93

Taking this view of the subject, Scheele's green is the normal tricupric arsenite, and corresponds to the triargentic arsenite described by Bloxam.

It is almost impossible, however, to obtain a perfectly constant product, from the strong tendency to form basic sulphates and basic arsenites.

As a matter of economy in the preparation, it will be found more advantageous to take the following proportions rather than those given by Scheele:—

	Parts.
Copper sulphate	6
Arsenic trioxide	2
Sodium carbonate, $Na_2CO_3 10H_2O$ ..	8

Dissolve the soda and arsenic in 10 parts of water, and the copper sulphate in 40 parts of water; filter both solutions if necessary. Mix while boiling, boil for a few minutes, and then allow to stand until next day; pour off the supernatant liquid, fill up the vessel with hot water; repeat this operation about three times, then filter, and dry at about 100° C.

In analysing these salts, the water was determined by ignition in a current of oxygen. The water being collected and weighed in a chloride of calcium tube. The arsenic was determined in various ways, but it was found that the conversion into arsenic pentoxide and trituration with uranium solution gave the most satisfactory results. The copper was determined with the battery.

The separation of copper and arsenic was made either by boiling with a slight excess of potassa with previous oxidation by nitric acid or bromine, or by adding potassa, and then passing hydrogen sulphide through the solution until the copper was completely precipitated.

My thanks are due to my assistant, E. R. Hills, for the able manner in which he has aided me by making many analyses of these salts—an undertaking that can be appreciated only by those who have tried working with copper and arsenic in combination.

Since the above paper was finished, I have succeeded in obtaining two samples of copper arsenite as found in commerce. The first of these resembled closely that analysed in Analysis No. XII. in colour, and on examination it was found to contain carbon dioxide and sulphur trioxide; the other resembled Analysis No. XVIII., and, like it, contained a trace of sulphate.

Analysis of China-Clays from Kin-Kiang, in China. —M. W. Kalmann.—

Silica (soluble)	0.501
Silica (insoluble)..	50·133
Alumina	32·737
Ferric oxide	0·955
Ferrous oxide	1·690
Manganous oxide	0·827
Lime	0·501
Magnesia	0·268
Potassa	2·520
Soda	traces
Loss on ignition	10·011
	100·146

—*Bull. de la Soc. Chim. de Paris.*

ANALYSES OF IRON ORES, LIMESTONES, COALS, &c., USED IN THE IRON MANUFACTURE IN SCOTLAND.

By WILLIAM WALLACE, Ph.D., F.R.S.E., F.C.S., Public Analyst for Glasgow, &c.

(Continued from p. 510.

TABLE IV.—OCHREY IRON ORES, CHIEFLY SPANISH, USED IN BLAST-FURNACES IN SCOTLAND.

Constituents.	I. Bilbao.	II. Bilbao.	III. Santander.	IV. Santander.	V. Oran.	VI. Porman.	VII. Perman.	VIII. Tuscany.
Peroxide of Iron	72·00	71·53	84·33	81·11	71·00	67·43	67·43	80·00
Oxide of Manganese	2·08	2·42	1·08	1·64	—	0·66	1·44	1·80
Lime	0·33	1·48	trace	trace	11·09	2·41	2·72	1·79
Magnesia	0·22	0·22	0·24	0·59	1·73	trace	0·36	0·24
Carbonic Acid	0·45	1·40	0·26	0·65	10·61	1·13	1·30	1·67
Phosphoric Acid	0·06	trace	trace	trace	—	0·11	trace	0·04
Sulphuric Acid	—	—	—	—	—	1·23	0·83	—
Alumina	4·92	4·58	0·83	2·14	0·74	1·76	4·33	1·40
Silica	6·04	7·00	1·12	1·80	1·36	17·46	13·40	2·28
Combined Water	10·50	9·11	10·34	9·95	1·87	7·79	9·19	10·78
Water at 212° F.	3·40	2·26	1·80	2·09	1·60			
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Iron	50·40	50·07	59·03	56·80	49·70	47·20	47·20	56·00

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 6, 1877.

Rev. WILLIAM GASKELL, M.A., in the Chair.

"*On the Action of Water and Dilute Saline Solution upon Lead.*" Part III. By M. M. PATTISON MUIR, F.R.S.E., Assistant Lecturer on Chemistry, the Owens College.

1. In the second part of these researches (*Proc. Manch. Lit. and Phil. Soc.*, xvi., 1) I showed that there is generally an increase in the solvent action of water and dilute saline solutions upon lead when the experiments are carried out in beakers covered with porous paper; also that exposure of large surfaces of liquid to the surrounding atmosphere generally tends to increase solvent action. Further, my experiments led me to conclude that the solvent action tends to attain a maximum when the volume of liquid is large in proportion to the surface of lead exposed. I also concluded that under favourable conditions the quantity of lead dissolved increases in an increasing ratio with time during which the action is allowed to proceed. (Compare par. 6). Finally, I expressed my belief that the purity of the lead upon which the various liquids are allowed to act, very materially conditions the solvent action of those liquids.

In the present communication I propose to bring forward further experimental evidence as regards some of these points, and also to touch upon certain circumstances conditioning the solvent action of dilute saline solutions upon lead which have not as yet been studied.

2. And the first point which demands attention is one which I merely mentioned in my second paper, viz., Does the relation between surface of lead exposed and total quantity of liquid influence the solvent action? In the following experiments the surface of lead exposed was maintained constant, the strength of the saline solution was also unchanged, but the total quantity of liquid was increased. Otherwise the experiments were carried out under exactly similar conditions.

Sometimes a slight increase is noticed in the quantity of lead dissolved by equal quantities of solutions, when the total volume of liquid is increased; on the other hand a slight decrease is sometimes noticed. I think that so far as these experiments go, we may conclude that a very large volume of liquid dissolves no more lead than a relatively small volume, when caused to act on the same amount of metallic surface.

TABLE I.

EXPERIMENTS CARRIED OUT IN BEAKERS HALF FILLED WITH LIQUID (500 C.C. IN EACH) AND COVERED WITH UNSIZED PAPER: DIAMETER OF MOUTH OF BEAKER = 11·5 C.M.

Salt.	Grams per Litre. of	Quantity Liquid. c.c.	Lead exposed. sq. cm.	Lead Dissolved (Mgms.) per 500 c.c. liquid. 11 dys.	21 dys.
Ammonium nitrate	0·20	250	50	1·8	1·5
,, ,,	0·20	500	50	2·5	2·5
,, ,,	0·20	750	50	2·5	2·5
,, ,,	0·20	1000	50	2·5	1·8
Potassium nitrate	0·20	250	50	2·5	1·8
,, ,,	0·20	500	50	1·5	1·8
,, ,,	0·20	750	50	1·3	1·3
,, ,,	0·20	1000	50	1·0	1·0
Calcium chloride	0·20	500	50	2·5	3·5
,, ,,	0·20	1500	50	1·3	2·0

3. The second question calling for an answer is—Does the quantity of lead dissolved increase with increase of time, or is there a maximum reached after which no further increase is noticeable?

Various experiments were carried out. Pieces of clean lead were immersed in different saline solutions for three months, and were then subjected to the action of various liquids. Comparable experiments, omitting the previous lengthened immersion in saline liquids, were also carried out. Special experiments in reference to potassium carbonate are detailed, inasmuch as in my last paper I had provisionally concluded that in the presence of this salt, the solvent action of water upon lead soon—comparatively speaking—reaches a maximum.

Fresh light is also thrown upon the question now under consideration by the results of experiments having for their special object a comparison of the solvent action of various liquids upon different samples of lead. (Par. 10.)

4. In order to compare these numbers with those obtained by submitting the same amount of surface of the same specimen of lead to the action of distilled water containing equal quantities of the same salts during the same intervals of time, I subjoin the following determinations taken from a paper already read before this Society (xvi., p. 3). The experiments were carried out under exactly similar conditions.

TABLE II.

LEAD IMMERSED IN STRONG SOLUTIONS OF THE UNDERMENTIONED SALTS FOR THREE MONTHS: THEN WASHED WITH A LITTLE DISTILLED WATER, AND IMMERSED IN VARIOUS SOLUTIONS.

EXPERIMENTS CARRIED OUT IN BEAKERS HALF FILLED WITH WATER (500 c.c. IN EACH) AND COVERED WITH UNSIZED PAPER: DIAMETER OF MOUTH OF BEAKER = 11·5 c.m.

A.—*Lead Immersed in Strong Solution of Potassium Carbonate.*

	Grams per Litre.	Surface of Lead exposed in sq. cm.	Total Lead, in Mgms., in Solution after—			
Then in—			6 dys.	15 dys.	38 dys.	62 dys.
Potassium carbonate	0·20	50	trace	trace	trace	trace
,, nitrate ..	0·20	50	0·40	1·00	1·00	1·20
Ammonium ,, ..	0·20	50	1·50	3·50	2·00	1·00

B.—*Lead Immersed in Strong Solution of Potassium Nitrate.*

Then in—						
Potassium carbonate	0·20	50	0·20	0·20	0·20	0·30
,, nitrate ..	0·20	50	0·30	0·30	0·20	0·30
Ammonium ,, ..	0·20	50	0·50	0·50	0·30	0·70

C.—*Lead Immersed in Strong Solution of Calcium Chloride.*

Then in—						
Potassium carbonate	0·20	50	0·20	0·20	0·20	0·50
,, nitrate ..	0·20	50	1·20	0·50	0·40	0·50
Ammonium ,, ..	0·20	50	2·50	0·80	0·60	0·80

D.—*Lead Immersed in Strong Solution of Ammonium Sulphate.*

Then in—						
Potassium carbonate	0·20	50	0·30	0·50	0·40	0·50
,, nitrate ..	0·20	50	3·00	3·00	1·90	1·80
Ammonium ,, ..	0·20	50	5·00	1·30	0·30	1·00

TABLE III.

Salt.	Grams per Litre.	Surface of Lead in sq. cm.	Total Lead in solution, in Mgms., after 18 days.
Potassium carbonate ..	0·20	50	0·3
,, nitrate ..	0·20	50	2·4
Ammonium ,, ..	0·20	50	3·8

In these experiments the lead had *not* been previously immersed in saline solutions.

5. The following experiments have especial reference to the action of time in determining the quantity of lead dissolved by a water containing potassium carbonate in solution.

TABLE IV.

EXPERIMENTS IN BEAKERS, CORKED FLASKS, AND BASINS, DETAILS OF MEASUREMENTS, &c., AS IN LAST PAPER (xvi., p. 3). IN EACH CASE 500 c.c. OF LIQUID CONTAINING 0·20 GRAMS OF POTASSIUM CARBONATE PER LITRE. 50 SQ. CM. OF SURFACE OF LEAD EXPOSED.

	Total Lead, in Mgms., in solution after—			
	8 days.	10 days.	12 days.	20 days.
Flask	0·20	0·20	0·20	0·20
Beaker	0·30	0·30	0·30	0·30
Basin	0·40	0·40	0·40	0·40

6. The results of these experiments are rather peculiar; they certainly show that the action upon lead of all the saline liquids with which I have experimented is an exceedingly complicated one, and that it is very difficult to separate one set of conditioning circumstances from all others.

In the case of potassium carbonate a maximum was reached so soon as at the end of eight days; after this time the quantity of lead in solution did not increase. If, however, the lead have been previously immersed in a solution of either potassium nitrate, calcium chloride, or ammonium sulphate, then the solvent action of the potassium carbonate solution continues to increase (at least, throughout so long a period as 62 days), although but to a very slight extent. Generally I conclude that the solvent action of saline solutions continues throughout very lengthened periods; certainly that it does so if the liquid be removed, and fresh liquid, holding the same or other salts in solution, be put in its place. In some cases, however, a maximum point appears to be reached after the expiry of 14 days or so, after which, if the liquid be undisturbed, little or no further solvent action occurs.

7. In some of these experiments a remarkable result is obtained, viz, the quantity of lead in solution is found to *decrease* after a certain point has been reached. In order to determine whether the same result could be obtained when the solvent liquids were not exposed to the air, the following experiments were carried out in corked flasks each containing 500 c.c. of water, the surface of lead exposed amounting as before to 50 sq. cm.

TABLE V.

Salt.	Grams per Litre.	Total Lead, in Mgms. dissolved after— 15 days.	32 days.	38 days.
Potassium carbonate ..	0·20	0·40	0·30	0·30
,, nitrate ..	0·20	0·90	0·70	0·60
Ammonium ,, ..	0·20	1·50	1·00	0·80

8. Here again we have a slight decrease in the solvent action of solutions of potassium and ammonium nitrates upon lead taking place after the expiry of lengthened periods. The lead would appear to be precipitated from solution after a time. A remarkable instance of such precipitation will be detailed in a future paragraph.

9. I must now consider the question of the purity of the lead itself as influencing the quantities of this metal dissolved by various liquids.

The experiments were carried out in flasks and beakers.

The sample of "pure" lead was found to contain very small traces of manganese, iron, and zinc; the "commercial" sample, No. I, contained small quantities of antimony and tin, very little iron, no manganese, copper, or bismuth, but traces of Aluminium; the impurities in No. II. sample were the same as in No. I., small quantities of copper being also present. The results are very startling. With No. I. sample of commercial lead, less lead was dissolved in almost every case than with "pure" lead; with No. II. sample, whose chemical composition appears almost the same as that of No. I., *very much larger* quantities were dissolved. I at once supposed that the fact noticed by some previous experimenters, viz., that mechanical treatment of lead alters its power of withstanding the action of solvents, must have materially influenced the results. That mechanical treatment does alter lead to an astonishing degree, so far as the action upon it of saline solution is concerned, will be made apparent from the experiments detailed in par. 12.

10. These experiments appear to show that it is not so much the chemical purity of the lead, as the mechanical treatment to which it has been subjected, which influences the solvent action of dilute saline solutions upon that lead. But the most remarkable feature in the numbers contained in Table VI. is the extraordinary falling off in the quantities of lead dissolved from No. 2 commercial sample when the experiments were carried out in beakers, as compared with the quantities dissolved in corked flasks. Taking, for instance, a solution of ammonium nitrate containing 0·20 grams of the salt per litre of water, it is found that 500 c.c. of this liquid, acting upon the surface of 25 sq. cm. of lead, dissolves 12·0 mgms. after 6 days' action, when the experiment is carried out in a corked flask nearly filled with liquid; but that the same quantity of the same solution acting on the same surface of the same lead is only able to bring a slight trace (*i.e.*, less than 0·20 mgm.) of lead into solution, after the expiry of the same time, when the experiment is conducted in a

TABLE VI.

EXPERIMENTS IN CORKED FLASKS, NEARLY FILLED WITH LIQUID (500 C.C.).

Salt	Grams per Litre.	Surface of Lead, sq. cm.	"Pure" Lead. Total Lead, in Mgms., dissolved after 6 days.	"Pure" Lead. Total Lead, in Mgms., dissolved after 15 days.	Commercial Lead, No. I. Total Lead, in Mgms., dissolved after 6 days.	Commercial Lead, No. I. Total Lead, in Mgms., dissolved after 15 days.	Commercial Lead, No. II. Total Lead, in Mgms., dissolved after 6 days.
Distilled water..	--	25	—	1·2	trace	trace	12·0
Potassium nitrate	0·20	25	0·9	1·2	0·3	0·4	5·0
Ammonium ,, ...	0·20	25	1·3	1·8	1·5	1·0	12·0
Distilled water..		50	0·7	0·9	0·5	0·5	16·0
Potassium nitrate	0·20	50	1·1	1·2	1·7	0·5	12·0
Ammonium ,, ...	0·20	50	1·4	1·5	7·0	7·0	7·0

EXPERIMENTS IN BEAKERS, 500 C.C. LIQUID IN EACH.

Distilled water..	—	25	0·4	0·5	0·3	0·3	0·5
Potassium nitrate	0·20	25	0·4	0·4	0·3	0·3	trace
Ammonium ,, ...	0·20	25	1·2	2·0	1·0	1·0	trace
Distilled water..	—	50	0·7	1·2	0·3	0·3	trace
Potassium nitrate	0·20	50	1·4	2·2	0·3	0·4	trace
Ammonium ,, ...	0·20	50	2·3	3·5	0·3	0·5	trace

beaker half filled with liquid and loosely covered with porous paper. The conclusion appears to be that the action of the air results in the formation of an insoluble lead salt. That this conclusion is the correct one appears from the following experiments. In the experiments with No. 2 sample of commercial lead very considerable precipitates formed on the lead itself and on the bottom of the vessels used. This was the case both in those experiments which were carried out in corked flasks and in those in beakers, but in the latter cases the precipitate generally appeared somewhat more bulky. On withdrawing a quantity of the clear liquid—holding lead in solution—from the flasks, and exposing it to the action of the air, a precipitate was in each case almost immediately formed. This precipitate increased in amount, until after a few hours a mere trace of lead could be detected in solution; the whole of the lead had been precipitated in an insoluble form. The corks were then withdrawn from the flasks, and the mouths loosely covered with porous paper; after 5 or 6 days the liquids contained only traces of lead in solution. From the liquids containing ammonium nitrate the lead was precipitated more slowly than from any of the others. The precipitate consisted of hydrated carbonate of lead $2PbCO_3,Pb(OH)_2$.

11. These results are apparently contradictory of those previously obtained, inasmuch as it has been already shown that in most cases more lead is dissolved when the air has free access to the surface of the liquid, and that the larger the surface of liquid exposed the greater is the amount of solvent action. I believe that the explanation of the results is to be sought for in the mechanical state of the samples of lead experimented upon.

12. With regard to the influence of hammering and rolling upon lead, so far as concerns the power of the lead to withstand the action of dilute saline solutions, I have meanwhile only a few experiments to bring before the Society. I propose, however, to investigate this subject in a more systematic manner, and hope, at a future date, to record the results.

TABLE VII.

EFFECT OF HAMMERING AND ROLLING ON LEAD.
EXPERIMENTS IN BEAKERS HALF FILLED WITH LIQUID (500 C.C. IN EACH) COVERED WITH UNSIZED PAPER.

Salt.	Grms. per litre.	Surface of Lead, sq. cm.	Nature of Lead.	Lead dissolved, in Mgms., after, 11 dys.	Lead dissolved, in Mgms., after, 21 dys.
Potassium nitrate	0·20	50	Thin Lead foil "pure."	1·50	1·80
,, ,,	0·20	50	4 or 5 sheets of same lead rolled together into compact piece	trace	0·30
				26 dys	0·30

So far as these experiments go, rolling several sheets of "pure" lead foil into one compact sheet, very materially decreases the solvent action exercised upon that lead by a liquid containing nitrates.

TABLE VIII.

EFFECT OF ROLLING AND HAMMERING ON SAMPLES OF COMMERCIAL LEAD (BEAKERS).

Sample No. 1.

Salt.	Grms. per litre.	Surface of Lead. sq.cm.	Nature of Lead.	Lead dissolved, in Mgms., after, 6 dy.	Lead dissolved, in Mgms., after, 14 dys.
Ammonium nitrate	0·20	25	As purchased	1·5	1·0
,, ,,	0·20	25	Several sheets rolled together then hammered	27·5	10·0
,, ,,	0·20	25	Several sheets hammered together, not rolled	trace	trace

Rolling several sheets of this lead together enormously increases the solvent action of ammonium nitrate upon the sample; hammering several sheets together has an opposite effect.

The following experiments illustrate the effect of rolling the original samples of commercial leads into thin sheets.

TABLE IX.

EXPERIMENTS CARRIED OUT IN CORKED FLASKS.

Sample No. 1.

Salt.	Grms. per litre.	Surface of Lead, sq.cm.	Nature of Lead.	Lead dissolved, in Mgms., after, 6 dys.	Lead dissolved, in Mgms., after, 15 dys
Water..	—	25	As purchased	trace	trace
Potassium nitrate	0·20	25	,,	0·3	0·4
Ammonium ,,	0·20	25	,,	1·5	1·0
Water..	—	25	Rolled out till much thinner	none	none
Potassium nitrate	0·20	25	,,	none	none
Ammonium ,,	0·20	25	,,	trace	trace

Sample No. 2.

Water..	—	25	As purchased	12·0	—
Potassium nitrate	0·20	25	,,	5·0	—
Ammonium ,,	0·20	25	,,	12·0	—
Water..	—	25	Rolled out till much thinner	trace	trace
Potassium nitrate	0·20	25	,,	trace	trace
Ammonium ,,	0·20	25	,,	—	10·0

Rolling these leads into thin sheets decreased the solvent action, except in one case, No. 2 sample with ammonium nitrate, when the action was not materially influenced.

TABLE X.

EXPERIMENTS CARRIED OUT IN BEAKERS (500 C.C. LIQUID IN EACH) LOOSELY COVERED WITH POROUS PAPER.

Salt.	Grms. per litre.	Surface of Lead. sq. cm.	Nature of Lead.	Lead dissolved, in Mgms., after, 10 dys.	15 dys.
Sample No. 1.					
Water	—	50	As purchased	0·3	0·3
Potassium nitrate	0·20	50	,,	0·3	0·4
Ammonium ,,	0·20	50	,,	0·3	0·4
Water	—	50	Rolled out till much thinner	trace	trace
Potassium nitrate	0·20	50	,,	trace	trace
Ammonium ,,	0·20	50	,,	trace	trace
Sample No. 2.					
Water	—	50	As purchased	trace	—
Potassium nitrate	0·20	50	,,	trace	—
Ammonium ,,	0·20	50	,,	trace	—
Water	—	50	Rolled out till much thinner	trace	—
Potassium nitrate	0·20	50	,,	trace	—
Ammonium ,,	0·20	50	,,	trace	—

In these cases rolling also tended to decrease solvent action. I hope to continue these experiments, and to lay the results before the Society at another time.

13. As a general rule I observed that the greater the quantity of deposit upon the lead the smaller was the quantity of lead in solution. The deposit always consisted apparently of the same salt, and appeared as light shining crystals, sometimes arranged in beautiful feathery forms upon the surface of the slips of lead. Analysis showed that this salt was of the same composition as that noticed several years ago by Miller, viz.,

$$2PbCO_3,Pb(OH)_2.$$

14. I wish to make a correction with regard to the action of dilute solutions of calcium chloride upon lead. In Part I. of the present papers I stated that this salt retards the solvent action of water upon lead; this conclusion was deduced from the results of a single experiment. Since that time I have performed many experiments with solutions of the salt in question, and the general result is, that water containing small quantities of calcium chloride in solution dissolves decidedly greater greater quantities of lead than are dissolved by pure water under similar conditions.

RUSSIAN CHEMICAL SOCIETY.

W. Sorokin, "*On Diallyl-methyl-carbinol.*" This non-saturated alcohol, $(C_3H_5)_2(CH_3)COH$, was obtained by the action of zinc on a mixture of 2 mols. allyl iodide and 1 mol. acetic ether, the yield being 16 per cent of the theoretical amount. The alcohol boils at 158·5°, possesses a characteristic odour, is insoluble in water, and has the specific gravity of 0·8638 at 0°. The acetic ether is obtained by treatment with acetic anhydride, and boils at 177°. By the action of bromine an unstable compound, $C_8H_{14}Br_4O$, is obtained, and a similar but still more easily decomposed body results from the action of bromine upon the acetic ether. Oxidation of the alcohol yields only carbonic and acetic acids.

A. Saytzeff, "*Notice on the Formation and Properties of the Alcohols belonging to the Series* $C_nH_{2n}O$." In the formation of these alcohols from the action of Zn and C_3H_5I upon oxygenated members of the fatty series, the author supposed that a derivative of the alcohol is first produced, in which the hydrogen of the group OH is replaced by the monovalent group ZnI,—

$$CH_3.CO.CH_3 + C_3H_5.ZnI = (CH_3)_2C(C_3H_5)(OZnI),$$

and that this decomposed by water yields the alcohol—

$$(CH_3)_2C(C_3H_5)(OZnI) + H_2O = (CH_3)_2C(C_3H_5)OH + ZnIOH.$$

A comparison of the boiling-points shows that the acetic ethers boil 18·4° higher than their corresponding alcohols, and that the latter, when compared with trimethyl carbinol—as well as the respective acetic ethers—exhibit an elevation of from 34° to 41° in the boiling-point at each replacement of CH_3 by C_2H_5. Oxidation does not serve in the case of the non-saturated alcohols to give a clue to the structure, as when used to distinguish between the primary, secondary, and tertiary alcohols of the saturated series. Instead of attacking the carbon atom joined to the hydroxyl group, as in the case of the latter, oxidising agents act, in the author's opinion, upon the carbon atoms joined together by double bonds.

M. Saytzeff, "*On Diallyl-oxalic Acid.*" This acid, $COOH.C(C_3H_5)_2OH$, the first of the diatomic, monobasic, non-saturated acids belonging to the series—

$$C_nH_{2n-4}O_3,$$

which has been prepared synthetically, is obtained in the form of the ethylic ether, by the action of zinc and allyl iodide upon oxalic ether. This ether is a colourless liquid, boiling at 213·6°, and by treatment with baric hydrate yields the acid in the form of an oil, which gradually becomes crystalline. A number of the salts are described. Oxidation yields no recognisable products. An ethereal solution of the acid forms, upon addition of bromine, tetra-bromo-diallyl-oxalic acid, $C_8H_{12}Br_4O_3$.

J. Kanonnikoff and N. Saytzeff, "*On the Preparation of Allyl Iodide and Acetic Anhydride.*" The ordinary preparation of allyl iodide is altered by allowing the reaction and subsequent distillation to proceed in an atmosphere of CO_2. By this means 1000 grms. of iodine, 3000 grms. of glycerin, and 300 grms. of phosphorus yield 1100 to 1150 grms. of C_3H_5I. Acetic anhydride can be prepared according to Linneman's method for obtaining butyric anhydride, by the action of acetyl chloride upon glacial acetic acid. The process gives 50 per cent of the theoretical amount.

A. Sebanijeff, "*Action of Zinc upon Organic Compounds containing Halogens.*" The action was studied upon the alcoholic solutions. Ethylen bromide and iodide, and propylen bromide are violently decomposed, forming C_2H_4, $ZnBr_2$, &c. Ethylen chloride is decomposed with difficulty, and trimethylen bromide is not attacked. Chloroform is acted upon very slowly by granulated zinc, but quite rapidly by zinc-dust, CH_4 being evolved. The presence of water favours the reaction, and would point to this decomposition:—

$$2CHCl_3 + 3H_2O + 3Zn_2 = CH_4 + 3ZnO + 3ZnCl_2.$$

M. Lewitzky, "*Upon the Existence of a Resistant Medium in Space.*"

ACADEMY OF SCIENCES, ST. PETERSBURG.

N. Zinin, "*On Isolepidene.*" The author finds that by the dry distillation of oxylepidene, oxylepidic acid, $C_{28}H_{22}O_3$, and isolepidene, $C_{28}H_{20}O$, are both formed, the latter amounting to one-half of the weight of the oxylepidene used. By treatment with zinc and acetic acid, isolepidene is changed into dihydrisolepidene, $C_{28}H_{22}O$, —a body melting at 182°, not easily attacked by chromic acid or oxidising agents, and resisting the action of chlorine and phosphorus pentachloride much more strongly than isolepidene. By reduction with sodium amalgam both isolepidene and dihydrisolepidine are changed into tetra-hydrisolepidine, $C_{28}H_{24}O$, melting at 132°, easily oxidisable to the dihydro compound. By the action of

oxidising agents, such as chromic acid, isolepidene is changed either into monoxy-isolepidene, $C_{28}H_{29}O_2$, or benzophenon, $(C_6H_5)_2CO$, according to the violence of the reaction, in both cases benzoic acid being formed. Monoxy-isolepidene melts at 161°, and is dimorph, the crystals being changed from one form to another by boiling with a small amount of alcohol. Reduction changes it into dihydrisolepidene.

H. WILD, "*On a Normal Barometer.*" In a lengthy paper the author maintains that the normal barometer of the Physical Central Observatory in St. Petersburg is the only one in existence giving the pressure directly, without further correction. The degree of possible error is limited to 1-100th m.m. The normal barometers of other countries are considered in detail; and he regards the instruments at Kew, Greenwich, London (Royal Society), Paris, and Vienna as entirely unreliable for absolute measurements. A list of the conditions necessary for the attainment of an accuracy of 0·025 m.m. is added.

CORRESPONDENCE.

THE ACTION OF ORGANIC ACIDS ON MINERALS.

To the Editor of the Chemical News.

SIR,—Permit me, through the medium of your widely-read Journal, to make a brief preliminary announcement of some results obtained in the course of an investigation now in progress. I refer to the behaviour of minerals with certain organic acids, with a special view to the application of the latter in determinative mineralogy.

Contrary to preconceived ideas, based on general notions of the weakness of organic acids, I find that many minerals in fine powder are decomposed by boiling with solutions of citric, tartaric, oxalic, and other organic acids. Not only do all the carbonates examined (fourteen in number) dissolve with effervescence in solutions of the above-named acids, but many sulphides, silicates, and other classes of minerals are more or less completely decomposed. In some cases the accompanying phenomena —such as evolution of gases, formation of crystalline, precipitates, &c.—are characteristic of certain minerals; for example, all the specimens of bornite examined yield sulphuretted hydrogen with tartaric acid (also citric and oxalic), while chalcopyrite does not; again, pyrrhotite yields sulphuretted hydrogen under similar circumstances, and pyrite gives no such reaction. Moreover, since citric and tartaric acids decompose potassium nitrate, setting nitric acid free, we have a powerful means of attacking sulphides and arsenides which resist the organic acids alone. All the sulphides examined (seventeen in number), with two exceptions, molybdenite and cinnabar, are quickly decomposed by heating with citric or tartaric acid to which a small quantity of potassium nitrate has been added. Even metallic copper, lead, tin, and silver dissolve in the above mixture of reagents. Potassium chlorate answers very well in place of the nitrate, but the action is slower. Oxalic acid fails to decompose the nitrate or the chlorate of potassium. The action of these acids on the silicates now engages my attention; several of them (natrolite, datolite, wollastonite, calamine, &c.) yield readily to the action of citric acid in solution, gelatinising as with mineral acids.

Aside from the interest which it seems to me attends those reactions, there is a manifest advantage in being able to add tartaric (or citric) acid to pocket travelling blowpipe-cases; the dry acids are readily transported, and can be dissolved when needed for use. It was during a mineralogical tour last summer that the thought suggested itself of trying the behaviour of minerals with tartaric acid, as a substitute for the mineral acids whose carriage is impracticable.

For microscopic work, also, the use of these non-volatile acids may be recommended, thus avoiding possible injury to the metallic mountings.

Besides the three organic acids named, I have examined the action, on carbonates at least, of malic, formic, and acetic acids, for sake of comparison; acetic acid gives the least satisfactory results.

So far as I can ascertain, this field has not hitherto been explored. I have ransacked chemical literature for similar studies in vain, and Prof. Edward J. Chapman, of Toronto, who is high authority in determinative mineralogy, writes me that while organic acids have long been used in chemical analysis, their direct application to the examination of minerals is, to the best of his knowledge, entirely novel.—I am, &c.,

H. CARRINGTON BOLTON.

School of Mines, Columbia College, New York,
February 7, 1877.

ESTIMATION OF UREA.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxv., p. 81) Dr. Dupré is reported to have read a paper before the Chemical Society "On the Estimation of Urea by Hypobromite." From your abstract of the above paper I gather that Dr. Dupré's apparatus is almost identical with that described by me in the CHEMICAL NEWS, vol. xxxi., p. 36. I, however, feel gratified by the fact that my apparatus has been found efficient by Dr. Dupré, and I take this opportunity of thanking him for explaining its merits to the Fellows of the Chemical Society.—I am, &c.,

RICHARD APJOHN.

Gonville and Caius College, Cambridge,
March 5, 1877.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—Mr. Pattison Muir's letter, relating to the 200 analyses by our ammonia process, carried out by his brother in Australia, affords another testimony to the wide-spread usefulness of the ammonia process, and as such was read by me with great pleasure. I am, however, bound to call attention to the fact that the alterability of polluted water when it is kept was well known to the discoverers of the process even so far back as the year 1867, and is alluded to in the various editions of the "Water Book." The direction on page 8, "The sample of water should be kept in a cool and dark place until it is examined; and the examination should, if possible, take place within forty-eight hours after the collection of the sample" was given because of our knowledge of the changes in water. On page 130 is a still more explicit statement.—I am, &c,

J. ALFRED WANKLYN.

OXIDISING ACTION OF ANIMAL CHARCOAL UPON ORGANIC MATTERS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxxv., p. 101, there is a paper by Mr. Thomson of great interest from many points of view. Would Mr. Thomson gratify your readers, if in a position to do so, by furnishing them with the analysis of the mixture of "prussiate char" and night-soil at the beginning of the experiment, and more especially with its present composition. What has happened to the total nitrogen he had to start with? How much is now present in the heap and in what form? How much gone to the atmosphere? I may mention that at a slaughter house near this city an experiment was lately made by taking 15 tons of waste flesh and animal offal, chiefly intestines, which were mixed with 2 tons seaweed char-

coal and 2 tons animal charcoal. The ingredients were as carefully mixed as possible and made into a heap, which stood for three months before being touched. I had never seen the heap till the end of that time, when it was noticed that clouds of steam were rising from the mass, and the temperature in the centre was as much as 130°. The smell of ammonia all round was very intense and on turning over any portion with a shovel was unbearable. This odour was, however, purely ammoniacal and had no cadaverous characteristic. The animal matter used contained 2·83 per cent nitrogen and 51 per cent water; the charcoal 0·4 per cent. The heap at the end of four months was found to yield 1·4 per cent nitrogen with 45·5 per cent water. The loss of nitrogen, chiefly to the atmosphere, amounted to 50 per cent of the total amount originally present. This was not encouraging to my friend who made the experiment, but I purpose to have another trial, using precautions to keep down the temperature if possible, and using acidified charcoal. If Mr. Thomson can supply any more particulars of his heap it would be very instructive.—I am, &c.,

ROBT. F. SMITH.

Glasgow, March 10, 1877.

P.S.—I omitted to state that no nitrates were found in the resulting compost.—R. F. S.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris,
No. 1, January 5, 1877.

Easy Method of Obtaining Glycolic Acid.—C. Z. Crommydis.—The author has obtained large quantities of glycolic acid, containing scarcely a trace of glyoxalic acid, by acting upon oxalic acid with zinc in the water-bath.

Watering of Wines and its Indications: Influence of Plastering, Glueing, &c., upon the Weight of the Dry Extract.—A. Gautier.—Not capable of useful abstraction.

Determination of Phosphorus and Arsenic by the Molybdate of Ammonia.—MM. Champion and H. Pellet.—M. Boussingault has shown that the approximation furnished by directly weighing the phospho-molybdate is superior to that obtained by re-dissolving the precipitate and determining the phosphorus as ammoniaco-magnesian phosphate. The error committed is the more appreciable the less phosphorus is present in the matter under analysis. According to M. Boussingault the phospho-molybdate contains 3·73 per cent of phosphoric acid. The operation may be performed very rapidly by observing the following precautions:—Dissolve 100 grms. molybdic acid in ammonia (about 150 c.c. of ordinary ammonia) and 80 of water. Pour it drop by drop into 500 c.c. of pure nitric acid and 300 c.c. of water. Stir, let settle, and filter if needful. Introduce into a capsule such a measure of the molybdic solution that the weight of the molybdic acid may be about fifty times the supposed weight of the phosphoric acid. Add ammonia to render the liquid alkaline; concentrate as far as possible the liquid containing the phosphoric acid, and mix the two solutions; raise the temperature to 70° to 80°, and pour in rapidly an excess of nitric acid until the yellow colouration appears, stirring briskly to aid the formation of the precipitate. Filter through a double tared filter, wash, and dry at 100° to 110°. The filtrate should be colourless. If it is yellow the precipitation is incomplete; in this case ammonia is poured upon the filter to re-dissolve the precipitate, the solution is evaporated, and re-acidified with nitric acid. The same process may be successfully applied to the determination of arsenic, 100 grms. of the precipitate of arsenio-molybdate of ammonia containing 5·1 of arsenic acid.

Catechu de Laval, a New Colouring Matter for Linen and Cotton.—This name has been given by MM. Croissant and Bretonnière to the sulphuretted organic colouring matters which they discovered some years ago. Though these products have no analogy with catechu they give certain catechu shades. The colour produced upon cotton is modified according to the method of fixation employed. The fixation is effected either with an acid (sulphuric or muriatic), with sulphate of copper, or iron, and especially with bichromate of potash. Catechu de Laval is characterised by its affinity for vegetable fibres, and by its power of serving as a mordant for a number of colours which are not capable of dyeing cotton directly, such as the aniline colours, the extracts of the woods, &c. To dye cotton, from ½ to 2 kilos. of the colour are dissolved in ten times its weight of boiling water, as pure as possible (especially free from lime) to 10 kilos. of cotton. As the solutions are unstable they must only be prepared as wanted. This solution is gradually strained into 100 litres of water at 60°. At the end of the dyeing bisulphite of soda is added to the bath in the proportion of 75 to 100 grms. per every 100 grms. of colour. The dyeing lasts from twenty to twenty-five minutes. The cotton is then washed, and passed into a hot beck of 300 grms. bichromate or of another fixing agent (sulphate of copper or iron) 200 grms. sulphuric acid, or 500 grms. muriatic acid. After a few minutes the cotton is taken out and dried. To obtain compound colours the cotton dyed as above, and well washed, is passed into baths of magenta, extracts of the woods, &c. Catechu de Laval may be used for dyeing jute, linen, &c. It must be preserved from damp.

Action of Alkaline Ferridcyanide of Potassium upon Colours obtained from Madder and its Derivatives, as well as upon its Artificial Substitutes.—M. Wagner.—On printing upon mordanted goods dyed in madder, garancin, or artificial alizarin, a thickened solution of ferridcyanide of potassium, and passing into a bath of caustic soda, the author finds that shades consisting entirely of alizarin resisted perfectly. Those containing purpurin were more or less impoverished, according to the proportion of purpurin present, whilst colours composed of purpurin alone were entirely discharged.—*Moniteur de la Teinture.*

A Steam Indigo Blue.—M. C. Zürcher.—A colour to answer all the conditions of such a blue ought to contain, besides the thickening, a reducing agent and a body neutral in the cold, and becoming alkaline at the temperature of the steaming process. Schlumberger proposed the cyanide of potassium, but this substance, in addition to its high price, is a dangerous poison. The author finds that the alkaline bicarbonates whose alkalinity is much heightened at 70° to 80° are then capable of dissolving white indigo. A colour formed of 1 litre of neutral gum-water, 250 grms. protoxide of tin in a paste, 100 grms. bicarbonate of soda, and 300 grms. of ground indigo at 20 per cent, is not reduced in the cold, but when heated reduction ensues, and the white indigo is dissolved. When printed upon the cloth the colour is only reduced by very moist steaming.—*Moniteur de la Teinture.*

No. 2, January 20, 1877.

At the meeting of the Society December 15, 1876, M. Lecoq de Boisbaudran stated that on roasting blende gallium and indium remain, which may be extracted by treatment with an insufficient quantity of sulphuric acid; sulphate of zinc is formed, whilst gallium and indium remain in the undissolved portion.

In the current issue of the *Bulletin* there are no original papers. The following memoirs are taken from other sources.

Preparation and Properties of the Chlorides, Bromides, and Oxide of Gold.—M. J. Thomsen.—This

paper taken from the *Journal fur Praktische Chemie*, New Series, xiii., 337) describes the intermediate chloride, $AuCl_4$, formed by the action of chlorine upon pulverulent gold, the anhydrous chloride $AuCl_3$, obtained by treating the foregoing compound with water; the hydrated chloride, $AuCl_3 + 2H_2O$; aurous chloride, AuCl, formed by the action of a temperature of 185° upon the anhydrous trichloride; the intermediate bromide and the anhydrous tribromide, analogous to the corresponding chlorides; the hydrobromate of tribromide, $AuBr_3H.5H_2O$; the aurous bromide, and the hydrated oxide.

Actions of Affinity Manifested in the Slow Oxidation of Hydrogen and of Carbonic Oxide under the Influence of Platinum Black.—M. E. von Meyer. The presence of carbonic oxide in mixtures of hydrogen and oxygen does not destroy but lessens the action of the platinum, the carbonic acid being oxidised in preference. —*Journ. f. Prak. Chemie.*

Thermic Researches on Gold and its Compounds.—M. J. Thomsen. —Not suitable for abstraction. —*Journ. f. Prak. Chemie.*

Action of Alcoholic Ammonia upon Oxalate of Methyl.—M. A. Weddige (*Journ. f. Prak. Chemie*).—The author on treating methylic oxalate with ammonia dissolved in ethylic alcohol obtains oxamate of ethyl.

Ethers of Sulphuric Acid.—M. Mazurowska (*Journ. f. Prak. Chemie*). —Not suited for abstraction.

Transformation of Para-oxy-benzoic Acid into Salicylic Acid.—M. Kupferberg (*Journ. f. Prak. Chemie*). This transformation, suggested by Ost, is only possible in part.

Utilisation of the Sulphur of Gypsum and of the Sulphate of Soda employed in the Glass Manufacture.—M. O. Schott (*Dingler*, ccxxi., 142). The author forms a double silicate of lime and soda by heating together silica, sulphate of soda, and gypsum with the quantity of carbon necessary to reduce these salts. Complete fusion of the mixture is not needed. The sulphurous acid evolved may be passed at once into the lead chambers. The double silicate produced—which the author calls *crude glass*—serves for the manufacture of glass by fusion along with silica, soda, or lime, according to the nature of the glass to be produced. The proportions for the crude glass itself may be modified as deemed requisite. One of the objections made by glass manufacturers is that the escape of gas during vitrification is necessary to render the mass homogeneous. But as each kilo. of the mass to be vitrified gives off 1 litre of gas, this quantity is much more than sufficient. A certain quantity of unreduced mixture may be added to complete the vitrification of the "crude glass." In the reduction of the sulphates we may substitute for carbon a sulphide, such as soda-waste; the sulphurous acid escaping is then free from carbonic oxide, and its transformation into sulphuric acid in the chambers is effected with more regularity.

Action of Various Saline Solutions upon Metals.—M. A. Wagner (*Dingler*, ccxxi., 259).—Copper is attacked by all the salts experimented with in presence of carbonic acid, especially by sal-ammoniac. Zinc is also attacked by all, most strongly by chloride of magnesium. Lead is attacked neither by potassic sulphate nor sodic carbonate. Tin is scarcely attacked by the alkaline chlorides, somewhat more by carbonates, and very strongly by caustic soda.

NOTES AND QUERIES.

Lubricating Mineral Oil.—Is it possible to bleach or discolour lubricating mineral oil?—E. R.

Elastic Cement for Iron.—Could any of your readers inform me of a cement that does not readily dry up and crack when exposed to the weather, and is sufficiently adhesive to stick to galvanised iron when placed in joints of sheets? I have tried white and red lead but they always dry rapidly and fall out of the joints.—C. F.

MEETINGS FOR THE WEEK.

MONDAY, 19th.—London Institution, 5.
— Medical, 8.
— Society of Arts, 8. (Cantor Lectures). "Chemistry of Coal Manufacture," A. Vernon Harcourt, F.R.S.
TUESDAY, 20th. Royal Institution, 3. Prof. Garrod, "On the Human Foot: its Structure in Relation to its Contour."
— Civil Engineers, 8. Discussion on "The Transmission of Motive Power to Distant Points" "The River Thames," by J. B. Redman, M. Inst. C.E.
— Zoological, 8.
WEDNESDAY, 21st.—Society of Arts, 8. "Vital Air," by Dr. W. B. Richardson, F.R.S.
— Meteorological, 7. "Results of Meteorological Observations made at Patras, Greece, during 1853 and 1855," by the Rev. Herbert A. Boys. "Contributions to the Meteorology of the Pacific—Fiji," by R. H. Scott, F.R.S. "Local Diurnal Range," by S. H. Miller, F.R.A.S. Several new Instruments will be exhibited by Messrs. Negretti and Zambra.
— Geological, 8.
THURSDAY, 22nd.—Royal, 8.30.
— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
— Philosophical Club, 6.30.
— London Institution, 7.
— Zoological, 4.
FRIDAY, 23rd.—Royal Institution, 9. "Influence of Chemical Constitution upon Refraction of Light," Professor Gladstone, F.R.S.
— Quekett Club, 8.
SATURDAY, 24th.—Royal Institution, 3. Prof. H. Morley on "French Revolution and English Literature."

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FRANCIS O'BRIEN, General Chemical Plumber, Etcher of the Glover Towers and Acid Plant in General.—Residence, 76, High Street, Jarrow-on-Tyne.

NOTICE.—A Commercial House in Holland, having the Best References, and being in Daily Connection with the Principal Flock-masters and Sheep-owners in Holland, wishes to have good AGENCIES FOR CHEMISTS' ARTICLES, such as SHEEP-DIPPING COMPOSITIONS, &c.—Apply, prepaid letters, to initials R. F., at Messrs. NYGH and VAN DITMAR'S General Advertising Offices, Rotterdam.

THE CHEMICAL NEWS.

VOL. XXXV. No. 904.

ON SOME PRELIMINARY RESEARCHES ON THE ACTION OF MAGNESIUM ON SOME ORGANIC COMPOUNDS.

By SERGIUS KERN, St. Petersburg.

MAGNESIUM acts on many organic compounds nearly in the same way as the copper-zinc couple in the experiments of Gladstone and Tribe. Ethylen iodide ($C_2H_4I_2$) and ethylen bromide ($C_2H_4Br_2$) with a small quantity of ethyl-alcohol and some pieces of magnesium, being gently heated, evolve readily pure ethylene (C_2H_4). Instead of ethyl-alcohol water may be used with the same results.

This reaction may be used with success in preparing pure ethylene for chemical researches.

Magnesium in powder acts very strongly on most of the organic compounds. It is better to use it always in a state of fine powder, obtained by the action of sodium on magnesium chloride.

With chloroform, and a small quantity of water, magnesium gives a very energetic reaction, with the evolution of methyl hydride—

$$2CHCl_3+3H_2O+6Mg=2CH_4+3MgO+3MgCl_2.$$

In the same way magnesium-powder acts on iodoform and bromoform.

If we act on an alcoholic solution of $C_2H_2Br_4$ by magnesium we obtain acetylene dibromide by the reaction—

$$C_2H_2Br_4+Mg=C_2H_2Br_2+MgBr_2.$$

Care must be taken not to apply heat, because, on heating, instead of acetylene dibromide acetylene is obtained:—

$$C_2H_2Br_4+2Mg=C_2H_2+2MgBr_2.$$

Propylene bromide ($C_3H_6Br_2$) with the addition of water and magnesium evolves pure propylene—

$$C_3H_6Br_2+Mg=C_3H_6+MgBr_2.$$

On ethyl bromide (C_2H_5Br) magnesium acts with the addition of H_2O and C_2H_6O very readily, with the formation of a compound C_2H_5MgBr, which yields $MgBr_2$ and $(C_2H_5)_2Mg$. In presence of water only, the brommagnium ethyl (C_2H_5MgBr) gives the hydrated bromoxide of magnesium and ethyl hydride—

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\};$$

With ethyl alcohol, if water is not present, the obtained C_2H_5MgBr yields C_2H_5OMgBr, and also the same gaseous product—ethyl hydride.

On ethyl iodide (C_2H_5I) magnesium acts in a corresponding manner.

All the above-mentioned reactions require a low temperature not more than 30° to 40°, and in some cases even less. The magnesium, in powder, may be used with far more success than any other reagents, in order to obtain various hydrocarbons from their numerous compounds.

These experiments are the continuation of some of my researches on the action of magnesium on certain metallic salts, which shewed many interesting reactions of this metal (CHEM. NEWS, vol. xxxii., No. 840; vol. xxxiii., Nos. 851, 863).

Magnesium ethyl—

$$\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}Mg$$

is easily obtained by the action of magnesium powder upon ethyl iodide; if slowly oxidised this compound is transformed into magnesium ethylate—

$$\left.\begin{matrix}2(C_2H_5)\\Mg\end{matrix}\right\}O.$$

Magnesium ethyl is a valuable reagent, by means of which many other organic compounds may be obtained far more easily than by the action of zinc ethyl.

Using instead of zinc ethyl magnesium ethyl, many compounds of the alcohol radicals with metals were prepared in a very pure state. By this way ethyl compounds of mercury, silicon, tin, boron, lead, and other metals were made.

Obouchoff Steel Works.

ON THE FORMATION OF "MOSS COPPER."

By W. M. HUTCHINGS.

DOUBTLESS many readers of the CHEMICAL NEWS have, like myself, taken great interest in Professor Liversidge's experiments and observations on the formation of moss gold and silver (CHEM. NEWS, vol. xxxvi., p. 68), and would welcome any further investigations and explanations bearing upon this very interesting and little-understood subject. What is, perhaps, the most interesting and curious fact recorded by Professor Liversidge, is the very low temperature at which the "moss" is formed. In the case of moss copper, I was greatly struck by some observations which I made during some experiments a couple of years since, and which I have repeated several times since reading the paper by Professor Liversidge. I took about ½ lb. of regulus (containing 65·9 per cent. copper) and fused it under borax in a clay crucible, pouring the molten mass into an iron mould. After cooling slowly (by using a thin mould and standing on a hot plate) the regulus was found to contain a large amount of disseminated copper, the fractured surface showing numerous veins, and little nests of needles and jagged points, in small cavities in the regulus, even to the naked eye, while a lens or microscope showed the entire surface dotted with particles of copper. When a small portion of the regulus was fused as above and cooled very rapidly, very little copper was visible under the microscope.

When a large button of regulus (½ lb. as above) had cooled in the mould for some time, so that it had been quite solidified for some minutes, it was laid on an anvil and broken in two by a blow with a hammer. It was still much too hot to hold in the hand, but had cooled far below redness, even in the centre. At the moment of fracture the surfaces exposed were perfectly clean and lustrous; looked at quickly with a lens, they showed only the little veins and nests and imbedded particles of the disseminated copper; but in the course of a minute or two they were seen to become slowly covered with a growth of minute copper filaments, which increased, till in some places it resembled a coarse velvet. After three or four minutes one of the halves was again broken in two, and again the fresh and lustrous surface of regulus exposed, which contrasted strongly with the surface already covered with "moss." The piece was now just cool enough to be held in the hand. In the course of a few minutes this also showed moss copper on the surface, though not nearly so much as the first fracture, and only in patches, which formed very slowly. In all cases the growth is most extensive on the hotter parts of the surface—those nearest the centre—and if large buttons of regulus are broken while still much hotter than above mentioned, a far thicker covering is rapidly obtained.

Of course there is no question here of this "moss copper," being formed at a temperature sufficient to soften copper. Even at the time of the first fracture, the centre of the button was not nearly at the temperature of melting lead, and when fractured the second time the pieces were certainly not ever 100° C. Nor is there any oxi-

dation of the surface of the regulus, for where this is seen in amongst the copper filaments, it retains its lustre as when freshly broken.

Seen under the microscope these filaments (which in these small experiments are exceedingly minute), exactly resemble the larger ones described by Dr. Percy, being deeply grooved and striated. Many of them are broad and flat, like blades of grass, as described by Professor Liversidge in the case of moss silver, and many seem to show plainly that they were formed by the union of several finer threads, as they look, when magnified, exactly like coiled wire rope.

Laboratory, Wallasey Ore Works, Birkenhead.

THE ACTION OF MANGANESE DIOXIDE ON AMMONIUM NITRATE.

A NEW METHOD OF PRODUCING NITROGEN.

By J. W. GATEHOUSE.

When binoxide of manganese is heated with ammonium nitrate, a violent action occurs, and if the external temperature is maintained the action may become so intense as to raise the contents of the vessel to dull redness, when abundance of the red vapours of nitrogen tetroxide are evolved.

The action begins at a temperature of 360° F., which is the point at which nitrate of ammonia itself decomposes, and if temperature is maintained between 360° and 390° F. great frothing occurs, and a constant stream of an invisible gas, which neither supports combustion nor is absorbed either by water or by solution of pyrogallic acid and potash, is evolved.

This gas is pure nitrogen, and is disengaged according to the following equation:—

$$MnO_2 + 4NH_4NO_3 = Mn_2NO_3 + 8H_2O + 6N.$$

320 grammes of ammonium nitrate should thus evolve 67,140 cubic centimetres of nitrogen at normal temperature and pressure.

An experiment, in which 3 grammes of ammonium nitrate were heated with an equal weight of manganese dioxide in a mercury bath to a temperature not above 400° F. yielded 606 cubic centimetres of nitrogen, a number sufficiently near to the theoretical amount 630 c.c. to show the above equation to be practically correct.

When the temperature is allowed to rise above 420° F. a more complex action ensues, the nitrate of manganese, being apparently decomposed into manganese dioxide, nitrogen tetroxide, and oxygen.

An analysis of the gas evolved at 430° F., after passing it through water, gave the following results:—

Gas taken, 12 c.c.; absorbed by water, nothing appreciable; after absorption by solution of pyrogallic acid and potash, 10·98 c.c. Amount of oxygen in 12 c.c. of gas = 1·02 per centage of oxygen, 8·5. As by the equation $MnO_2 + 2NH_4NO_3 = Mn_2NO_3 + N_2 + 2H_2O + H_4$ it was possible that hydrogen might be evolved, a special experiment was made with electrolytic gas and excess of oxygen by combustion in an eudiometer, but with negative results, no hydrogen being discoverable.

We are thus warranted in coming to the conclusion that at temperatures between 360° and 400° F. a mixture of equal weights of manganese dioxide and ammonium nitrate yield pure nitrogen, but that at temperatures above 420° tetroxide of nitrogen and oxygen are also evolved from the decomposition of the nitrate of manganese first formed.

The Laboratory, 36, Broad Street, Bath.

Substitution of Borate of Lime for Lime in Refining Sugars.—The use of the monoborate of lime in sugar refining prevents the formation of glucose, and diminishes the proportion of crystalline sugar going off in the form of treacle.—*Les Mondes.*

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 89.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

Roasting of Various Metallic Sulphides.—At Freiberg and in the Harz galena is used for the manufacture of sulphuric acid, and is roasted for this purpose in large wide shaft-furnaces containing 250 cwts. The ore gives off the half of its sulphur and yields a gaseous mixture containing 4 to 6 per cent of sulphurous acid.

Copper pyrites are used for making sulphuric acid both at Chessy and at Oker in the Harz, and are roasted for this purpose in small tubes. At Mansfield also copper ores are desulphurised in kilns, the Gerstenhöfer furnaces introduced for this purpose having been abandoned. In Swansea, on the other hand, the ground ore is roasted in Gerstenhöfer furnaces, which are there found to work satisfactorily. The lead chambers at Swansea are at the distance of about 20 metres from the furnaces, so that the greater part of the flue dust is deposited before reaching the chambers.

In the "Report on the London Exhibition of 1862," Dr. A. W. Hofmann† mentions that Lawes, of Barking Creek, on the Thames, employs in the manufacture of sulphuric acid the oxide of iron which has served for the purification of coal-gas, and which has become rich in sulphur. This so-called "Laming's mass" is now also used by the St. Gobain Company, of Aubervilliers, near Paris; by Seybel, of Liesing, near Vienna; by Kunheim and Co., of Berlin, and probably also elsewhere. The roasting is conducted partly upon earthen plates, partly in furnaces with narrow grates, the gases obtained being well suited for the manufacture of sulphuric acid.

Zinc blende has found of late years a more extended employment in the manufacture of sulphuric acid, and its use will probably be further extended. The chemical works "Rhenania," at Stolberg, near Aachen, may claim the merit of having thoroughly studied the utilisation of the gases escaping on roasting zinc blende and of having carried the process out in the most complete manner. Twenty years ago blende was roasted at Stolberg in a reverberatory furnace of two stages, according to F. W. Hasenclever's patent. The upper hearth formed a muffle constructed of vaults, in which the blende underwent a preliminary roasting, the sulphurous acid evolved being passed into the chambers. The roasting of the ore was then completed on the lower hearth. When pyrites were cheap it was not remunerative to use blende, as the desulphurisation remained imperfect and gases too poor in sulphurous acid entered the chambers. The simple muffle-furnace was improved by Eugene Godin, whose plan did not come into operation at Stolberg until 1865, after his death. The ores, before arriving upon the hearth of the reverberatory heated by the products of combustion pass over seven plates of fire-clay, arranged one above another. The spent ores are withdrawn below, the charge of the second is removed to the first, that of the third to the second, &c., and green ore is thrown upon the seventh. In this furnace the roasting took place in a satisfactory manner, and the gases were rich in sulphurous acid. Labour, however, was high, and the loss of gas whilst charging was considerable. If the draft was increased the gases were too much diluted by the entrance of air at the doors.

In 1866 the Gerstenhöfer furnace was introduced at Stolberg for roasting zinc blende and used for some time.

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† A. W. Hofmann, "Reports by the Juries," 1862, 15.

At the best it only succeeded in utilising half the sulphur of the blende. On the other hand, the amount of flue dust (the blende there in use being very finely granular) was excessive, so that this furnace has proved as little adapted for roasting blende at Stolberg as at Borbeck and Swansea.

Since 1870 the muffle-furnaces formerly employed at Stolberg have been combined with a system of plates according to the design of Hasenclever and Helbig. The system has subsequently experienced important modifications, retaining the principle for inclined plates, until a kiln for blende has been developed which has now for some years been found suitable to be retained in an unmodified form.* The products of combustion, which play round the muffle, heat from below an inclined plane formed of plates and about 8 metres in length. On this inclined plane the ore slides down to a roller fixed at the lower end, and as this revolves is delivered first into the muffle, whence it is drawn down by manual labour into the lower hearth, where it is roasted until fit to be smelted for zinc. The gases escaping from the muffle, still poor in sulphurous acid, sweep over the inclined plane, become richer, and effect a preliminary roasting of the blende. Since finely granular bodies if thrown on a heap form a surface with an approximately constant angle of 33°, as the ore slides down the plane which has an inclination of 43° there would be formed at the bottom a heap of more than 1·5 metre in depth, a perfect roasting of the interior of which would be impracticable. To prevent the stratum of ore from becoming too thick partitions are arranged, which descend to the distance of a few centimetres from the slope. In this manner a thin stratum of ore is maintained over the whole surface. Furnaces of this construction are at work at Oberhausen and Stolberg, and are in course of construction at Lethmathe, near Iserlohn, and Rosdzin, in Silesia. The consumption of fuel is the same as in the roasting kilns common at zinc works, 28 per cent of coal to 100 raw blende; the cost of labour is 1·6 of a shilling per 100 kilos. blende.

In Freiberg a black blende, containing iron pyrites in considerable amount, is used for the manufacture of sulphuric acid, the broken ore being submitted to a preparatory roasting in large kilns. The burnt residue is then ground and receives its final roasting in a reverberatory.

Formation of Sulphuric Acid in the Lead Chambers.—Recently, as well as in earlier years, proposals have been made to substitute some other apparatus for the chambers. Verstraet† employs for this purpose columns formed of earthen vessels. But his method, like earlier suggestions for preparing sulphuric acid on any other than the traditional principle, has not become of practical importance.

The chemical process during the formation of sulphuric acid in the chambers, and the reactions involved, have been latterly further explained.

Reich‡ introduced a method of determining the sulphurous acid in the gases from the kilns and furnaces, which has met with an extensive application. He uses a solution of iodine in potassic iodide of known strength, to which a little starch has been added. By aspiration the gas is drawn through the blue liquid till decolouration is effected. If the volume of the aspired gases has been measured the percentage of sulphurous acid is known. This method of examination has the great advantage that it can be accurately executed by a common labourer (?), the solution of iodine merely being prepared in the laboratory.

The composition of kiln gases theoretically the most advantageous was first calculated by Gerstenhöfer, and was communicated to several chemical works as early as 1866. The same calculation, with a slight difference, was subsequently produced by Schwarzenberg.‖ According to his assumption, when the chambers are working well the gaseous mixture leaving them should still contain 5 per cent (by volume) of oxygen. Hence the normal composition of the gases entering, when sulphur is employed, must be:—

Sulphurous acid (by volume) ..	11·23
Oxygen	9·77
Nitrogen	79·00

and when pyrites are in use, and the gases at their exit contain 6·4 per cent of oxygen—

Sulphurous acid	8·59
Oxygen	9·87
Nitrogen	81·54

Since, for every 1000 grms. of sulphur used in the form of bisulphide of iron 8144·9 litres of gas (calculated at 0° temperature and at a pressure of 760 m.m. of mercury) enter the chambers, and for the same weight burnt in the free condition only 6199 litres, a given quantity of sulphur burnt as bisulphide of iron, yields—

$$\frac{8144{\cdot}9}{6199} = 1{\cdot}314$$

times as much gas as if it had been burnt in the free condition.

(To be continued.)

* Hasenclever and Helbig, *Zeitschr. des Vereins Deutscher Ingenieure*, 1872, 705.

† Verstraet, *Dingl. Pol. Journ.*, clxxix., 63. *Wagner Jahresber.*, 1865, 226.

‡ Reich, *Berg und Huttenm. Zeitung*, 1858.

‖ Schwarzenberg, "Bolley's Handbook der Technologie," ii., 355.

SHORT REPORTS FROM THE CHEMICAL LABORATORY OF TRINITY COLLEGE, DUBLIN.

By J. EMERSON REYNOLDS, M.D., M.R.I.A., Professor of Chemistry, University of Dublin.

No. I.—*On Glucinum: its Atomic Weight and Specific Heat.**

Amongst the few rare elements found in Ireland is the metal glucinum or beryllium, which occurs in the well-known alumino-glucinic silicate, beryl or "emerald." This mineral is found in comparative abundance, though in a rough state, in the granites of Donegal, and is somewhat less freely distributed through the granites of the Mourne Mountains, in the county of Down. As the "atomic weight" of glucinum has not yet been definitely fixed by the determination of the specific heat of the metal, it seemed desirable that we in Ireland should make the necessary crucial experiments. Hence, about seven years ago, I commenced to collect the crude Irish beryls or "emeralds," and ultimately succeeded in obtaining 3 kilogrammes of the dressed mineral, from which I prepared nearly 350 grms. of the pure glucinic oxide.

I have to thank my friend Mr. William Harte, C.E., the excellent County Surveyor of Donegal, for the valuable assistance he kindly afforded me in collecting much of the mineral from which the glucinic oxide was prepared.

The satisfactory nature of the results of a set of preliminary experiments with the material at my disposal must be my apology for laying a short communication upon the subject before the Academy at a very early stage of the investigation.

Some glucinic oxide was converted into the anhydrous chloride by the action of chlorine upon it at a full red-heat in presence of finely divided carbon; and the metal was subsequently procured by the action of metallic sodium on the pure sublimed glucinic chloride. The reduction was effected by heating a suitable mixture in a platinum vessel; but the temperature was not allowed to rise sufficiently to liquefy the mass; and on removal of the material from the crucible, those portions which had been in contact with the platinum were rejected. The resulting mixture of sodic chloride and reduced glucinum was then fused under common salt in a lime crucible; this precaution was taken in order to avoid contact with siliceous com-

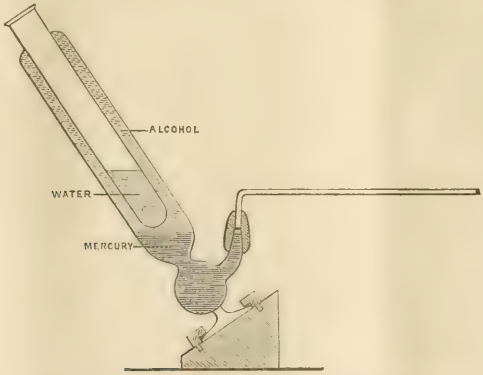
* Read before the Royal Irish Academy, April 10, 1876.

pounds. Considerable loss occurred in this operation; but I succeeded in obtaining a small coherent mass of metallic glucinum, which latter was found to agree in characters with the metal described by Debray,* though that distinguished chemist effected the reduction of his metal in a different manner.

If we admit, with Awdejew and with Debray, the number 4·6 to be the equivalent of glucinum (H = 1), the question remains whether the atomic weight, so-called, is a multiple of the equivalent by 2 or 3.

If, as some assert, the atomic weight is $4{\cdot}6\times3=13{\cdot}8$, the only known oxide of glucinum must resemble alumina. If, on the other hand, the atomic weight is $4{\cdot}6\times2=9{\cdot}2$, glucina must be an oxide like that of zinc or of magnesium. Each view has received the support of a group of chemists of the highest eminence; but, owing to peculiar difficulties surrounding the case, an appeal to chemical criteria has hitherto been insufficient to decide between the two conflicting opinions—a determination of the specific heat of the metal, or of the vapour-density of one of its compounds of simple constitution, being necessary for the final settlement of the question. Of these methods I chose the former; and having made several determinations of the capacity for heat of metallic glucinum, I have the gratification to state that the data obtained lead to the conclusion that the atomic weight of glucinum is double the equivalent weight. Glucinum is therefore a diatomic metal with an atomic weight of 9·2—though, I may add, this number may be slightly affected by a new determination of the equivalent, in which I am engaged.

matter have the same capacity for heat, when we compare them to the solid state. The outstanding exceptions to this important law are few; and even these appear to have been cleared away in some degree by the recent researches of Weber on the specific heats of silicon, boron, and carbon. The principle, however, is admittedly sufficiently general in its application to enable us to found upon it a plan for the determination of the atomic weight, so-called, of a particular element; for it is evident that if we employ as a standard a metal whose atomic weight and specific heat are both accurately known—silver for example (= 108)—the weight of another solid element, which contains the same quantity of heat at 100° C. as 108 parts of pure silver at 100° C., is the atomic weight of the element. In seeking to compare glucinum with pure metallic silver in this way, I succeeded in arranging an experimental method which not only enabled me to attain the object I had in view, but also to demonstrate the truth of the law just referred to. The apparatus required is easily constructed, and consists of a spirit-thermometer with a cylindrical "bulb" in which a test-tube is sealed, after the manner of Bunsen's ice-calorimeter. This part of the apparatus can be conveniently made from a small chloride of calcium drying-tower, as shown in the diagram. Although the larger "bulb" of the thermometer is full of spirit, the lower one and the stem are full of mercury, and connected with a fine capillary tube carefully graduated in millimetres, and calibrated. The arrangement constitutes an exceedingly delicate spirit-thermo-meter, with a mercury index.



The method pursued in making the necessary determinations upon which to found the conclusion just stated was devised for the purpose of this inquiry; and as it is essentially different from any with which I am acquainted, I may be permitted to indicate very briefly the plan adopted after a good deal of preliminary investigation.†

The well-known law of Dulong and Petit, as modified by Cannizaro, asserts that the atoms of elementary

When it desired to compare a solid element with silver, in order to fix the atomic weight, it is necessary to make a preliminary experiment with the standard metal. For this purpose one cubic centimetre of distilled water is placed in the test-tube, which is immersed in the bulb of the thermometer; and when the temperature has been equalized, and the thread of mercury has reached a suitable position in the stem a piece of pure silver weighing 108 centigrammes and heated to 100° C. in steam, is rapidly dropped into the cubic centimetre of water, and the expansion caused in a given time carefully noted.*

According to the law above stated, a centigramme atom, if I may use the term, of any other metal than silver, ought to cause exactly the same expansion when the experiment is made with it under precisely the same conditions; and these conditions are very easily realised. I have ascertained that such is the case; and the approxi-

* *Annales de Chemie et de Physique*, troisième serie, tom. xliv., p. 5 (1855).

† The preparation of pure metallic glucinum in quantities exceeding 2 or 3 grms. is difficult and costly. For this amongst other reasons I determined to employ Bunsen's admirable and theoretically perfect ice-calorimeter in the estimation of the specific heat of the metal, as small quantities of material only are required. It proved, however, to be impossible, owing to various engagements, to prepare the glucinum in a state of sufficient purity until the season had passed when Bunsen's ice-calorimeter can be conveniently used. I had therefore to devise a calorimetric method which could be employed during the warm weather, and which could afford trustworthy results with small weights of material. I have given in the text an outline of this method; but the details of its application to the determination of atomic and molecular heat will form the subject of another communication.

* The apparatus is carefully protected from the influence of air currents during an experiment.

mate equality in "atomic heat" of many of the metals has thus been easily demonstrated.

The comparison of glucinum with silver was made on this plan; and it was found that the weight of glucinum which contains nearly the same quantity of heat at 100° C. as 108 centigrammes of silver at the same temperature is not 4·6 or 4·6×3, but 4·6×2, or 2·2 centigrammes.

The "atomic heat" of silver, or the product of the specific heat (=0·05701 according to Regnault) into the atomic weight (=108), is 6·157. Using this number as the standard for reference, the experimental number found for the atomic heat of the specimen of glucinum operated with is 5·91. Thus:—

Atomic heat of silver . .	=6·157
Atomic heat of glucinum .	=5·910

The difference is less than the known difference between the atomic heat of silver and that of aluminum; but I am inclined to think that the lower number found for the glucinum used is due to the presence of a little platinum in the specimen of metal. Owing to the high atomic weight of platinum (=197·1) as compared with that of glucinum (9·2), the presence of even a small quantity of the former metal must very sensibly affect the determination of the atomic heat of glucinum. I hope soon to be in a position to continue these experiments with the *pure* metal.

It will, however, appear from the following considerations that we may fairly regard the above determination of the atomic heat of glucinum as being of such value as to enable us, even at an early stage of the enquiry, to use it as a physical control, and to fix the atomic weight of the metal, subject of course to the probably small change in the numerical expression which may prove to be necessary as the investigation proceeds.

If we assume the atomic weight of glucinum to be 9·2, and employed the value I have obtained for the atomic heat *i.e.*, 5·91, we can calculate the specific heat of the metal by means of the formula—

$$S = \frac{H}{A}, \quad \ldots\ldots\ldots \quad (1)$$

when S represents the specific heat, H the atomic heat, and A the atomic weight of an element. The specific heat of glucinum thus calculated is 0·642.

If now we substitute for H a constant, which in this case is the product of the well-ascertained atomic weight of silver† into its equally well-determined specific heat, AS=6·157, the expression becomes—

$$S = \frac{6{\cdot}157}{A}; \quad \ldots\ldots\ldots \quad (2)$$

and with its aid we can calculate the specific heat of any solid element, if its atomic weight is known or assumed. I have thus calculated the specific heat of glucinum on the assumption (*a*) that its atomic weight is 9·2, (*b*) that its atomic weight is 4·6, and (*c*) that it is 13 8.

The results are compared in the following table with the specific heat obtained by calculation from the actual determination of the heat of the metal:—

Specific heat of glucinum calculated (1) from the result of determination of atomic heat—

A=9·2 . . . . . 0·642.

Specific heat of glucinum calculated by (2).—

When A= 9·2	0·669
When A= 4·6	1·338
When A=13·8	0·446.

I am therefore justified in concluding that the atomic weight of glucinum is nearly if not exactly 9·2.

† We might obviously take any other product; but that of silver is here preferred because the atomic heat of that metal has been employed as the standard for reference.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 15th, 1877.

Professor ABEL, F.R.S., President, in the Chair.

THE visitors having been announced and the minutes of the preceding meeting read and confirmed, the names of Messrs. Carl T. V. Buch, H. Senier, S. G. Thomas, J. H. Poland, and J. Y. Buchanan were read for the first time. Mr. Frank W. Young was elected after his name had been read the third time.

The first paper "*On Isomeric Nitroso-Terpenes*," by Dr. W. A. TILDEN and Mr. W. A. SHENSTONE, was read by the SECRETARY. After alluding to the former paper by Dr. Tilden on the same subject, the authors described the methods they now employ for the preparation of the nitroso-chlorides of the terpenes, and which consists in passing gaseous nitrosyl-chloride into a well cooled mixture of the terpene with chloroform or with ordinary spirit, when the new compounds usually separate in the crystalline state. In this manner nitroso-chlorides have been obtained with the terpenes from both dextro- and lævo-gyrate turpentine oils, from oil of sage, and from oil of juniper; it is an important fact that although all these terpenes differ widely in their action on polarised light and in their other physical properties, yet the nitroso-derivatives, obtained by the action of alcoholic potash on the nitroso-chlorides are all without action on polarised light, melt at the same temperature, and agree apparently very closely in their crystalline forms. The nitroso-chlorides of that class of terpenes, boiling at about 175°, of which hesperidene, from orange peel oil, is a type, were also examined; crystalline compounds being obtained from hesperidene, oil of caraway, bergamot, and with some difficulty from essence of lemon. The nitroso-chlorides from the two first when carefully heated in small quantities at a time yielded crystalline nitroso-derivatives, although none could be obtained by the process found to answer so well with the terpenes of the first class, namely, treatment with alcoholic potash. The authors believe that this method will not only serve to discriminate the different isomeric terpenes, but also to show that a large number of the natural terpenes are merely physical isomerides and not distinct chemical compounds.

Prof. MASKELYNE said he was engaged in examining the crystalline forms of the substances described in this paper, but the investigation was not yet completed. He might say, however, that the crystals from the first group of terpenes, although at first sight they appeared very different, seemed really to belong to one and the same system. The crystals from hesperidene and caraway were very simple, and had very few faces to them, but he believed they belonged to a different system from the other group.

The PRESIDENT, having thanked the authors,

Dr. J. H. GLADSTONE read a paper by himself and Mr. A. TRIBE on the "*Preparation of Copper-Zinc Couples.*" The object of the numerous experiments detailed in this paper was to ascertain the best formula for the preparation of the couple; and for this purpose it was necessary to ascertain the influence exerted both by the proportion of copper deposited on the zinc foil, and also by its state of aggregation, the latter varying with the strength of the solution of copper sulphate employed to attack the zinc. The results showed that the couple of maximum activity was obtained by depositing the copper from a 2 per cent solution of the sulphate in six successive depositions, if it was to be employed in the decomposition of water, or for preparing ethyl hydride from a mixture of alcohol and ethyl iodide. For dry couples, however, such as those used in the preparation of the organo-zinc compounds and similar

eactions, one deposition from a 2 per cent solution was found to be most effective. The activity of these couples, from the results of experiments instituted with that object, was ascertained to be more than 1000 times greater than that of pure zinc. This paper was illustrated by numerous experiments.

The PRESIDENT said the authors had brought before them so many interesting results during the last few years, in connection with the copper-zinc couple, that their best thanks were due to Dr. Gladstone and Mr. Tribe for the lucid and precise details they had given them that evening as to the best way of making the most effective couple.

In reply to a question by Dr. WRIGHT as to whether other copper salts had been tried for the preparation of the couple, and, if so, whether the conditions of maximum activity were the same,

Dr. GLADSTONE said experiments had been made with other salts of copper, but not quantitatively, the object being to ascertain the best way of making the most active couple, therefore copper sulphate had been used as being most convenient.

Mr. KINGZETT said that Dr. Paul, who had used the copper-zinc couple for estimating nitrates and nitrites in water, had found a great difference in the results obtained with couples prepared with solutions of copper sulphate of different strengths.

Mr. E. RILEY then gave a short account of "*Chromium Pig-Iron.*" A quantity of pig-iron, which has recently been made in Australia, instead of having the ordinary qualities of pig-iron, was found to be exceedingly hard, and to present the appearance of the specimen exhibited. The ore employed in the manufacture had been analysed in this country by six or seven different chemists, all of whom, with one exception, had overlooked the presence of chromium, which might perhaps be accounted for by the fact that the specimen of ore sent over contained but a mere trace of chromium. The pig-iron from this ore, however, contained 6 to 7 per cent of chromium, as might be seen from the analysis given of two samples:—

	I.	II.
Chromium	6·984	6·287
Carbon	4·418	4·200
Silicon	1·460	0·976
Sulphur	0·102	0·207
Phosphorus	nil	0·055
Iron	—	88·343
Manganese	0·125	nil

From this it could readily be seen that the relation between the amount of carbon and sulphur was quite abnormal. As some 1200 tons of this iron had been manufactured it was important to know what to do with it. It had been stated that chromium plays the same part as manganese in iron, but in experiments made to ascertain if this chromium pig-iron could be substituted for spiegeleisen in the manufacture of Bessemer steel, very unsatisfactory results were obtained, the steel breaking up under the hammer. When mixed with one-half hæmatite and puddled it melts with difficulty, but although the chromium soon goes out in the cinder, the iron produced would not weld.

The PRESIDENT said Mr. Riley's communication possessed considerable interest, but he himself should have considered it very unlikely that this chromium iron would play the part of spiegeleisen. He had examined a specimen of the so-called chromium steel, but had found a mere trace of chromium in it. It was possible, however, that the chromium exerted a function in the production of the steel, but was eliminated at some stage in the process, so that it did not appear in the finished steel.

Mr. RILEY, in answer to some remarks on the subject, expressed his opinion that the colour test, although it could be depended on for the determination of the amount of carbon in steel, was very untrustworthy when applied to iron, the determination of the carbon by combustion after removal of the iron being the most reliable. He had found that the chromium had dissolved with the iron during the ordinary treatment for analysis.

Mr. C. E. GROVES then read a "*Note on Gardenin*," by Dr. J. STENHOUSE and himself. Gardenin was discovered by one of the authors some twenty years ago in "Dekamali gum," an Indian drug, but the quantity obtained at that time was too small for analysis. Recently, however, they have obtained a larger specimen of the resin and extracted the gardenin from it. It crystallises in deep yellow needles, which melt at about 164° and are somewhat difficult to purify. The results of the analysis agree very well with the formula $C_5H_5O_2$, which requires 61·86 per cent carbon and 5·15 hydrogen, whilst the numbers obtained by Flückiger were 59·47 carbon and 6·71 hydrogen. It is probable, however, that the specimen he analysed, and which melted at 155°, was contaminated with a colourless fatty substance of low melting-point present in the resin, and which is not entirely removed even by repeated crystallisation from spirit. The authors find when gardenin is dissolved in glacial acetic acid, and carefully treated with nitric acid in the cold, that a red crystalline substance is formed which melts at about 236°. It crystallises in long needles, which are insoluble in water, and almost insoluble in alcohol. As it is insoluble in dilute acids, but soluble in dilute alkaline solutions, from which it is re-precipitated on the addition of an acid, it has been provisionally named *gardenic acid*. The authors hope soon to be in possession of a large quantity of dekamali gum, which will enable them to continue this investigation. A note on ginger was appended to this paper, in which it is shown that the resin in ginger when fused with an alkaline hydrate yields proto-catechuic acid.

After the PRESIDENT had thanked the authors in the name of the Fellows,

The SECRETARY read two papers by Mr. M. M. P. MUIR, the first of which was an "*Additional note on a Process for Estimating Bismuth Volumetrically*," in which the author gives a modification of his former process; he now precipitates the acid solution of bismuth nitrate with excess of sodium acetate, dissolves the precipitate by means of a slight excess of acetic acid and titrates with a standard solution of potassium dichromate. The second paper was "*On Certain Bismuth Compounds, Part IV.*," in which a chromate of bismuth, $3Bi_2O_3,2CrO_3$, is described as obtained by the action of a hot potash solution on the chromate, $3Bi_2O_37CrO_3$. The formation of the compounds $Bi_2O_5xH_2O$ and $Bi_2O_4xH_2O$, by the action of chlorine on bismuthous oxide suspended in a hot solution of potassium hydrate, is then considered, and it is also shown that the oxide, Bi_2O_5,H_2O, when dissolved in an acid and precipitated with an alkali, always yields bismuthous hydrate, $Bi_2O_3xH_2O$, whether the solution has been previously subjected to the action of reducing agents or not. The author concludes this part of his paper by discussing the formulæ of the six known hydrates of bismuth. There is an addendum on the action of potassium ferrocyanide on bismuth solutions, from which it appears that in presence of nitric acid bismuth ferrocyanide, $Bi_{45}FeCy_6$, is first produced, quickly passing, however, into the ferricyanide, $Bi_{35}FeCy_6$, which, in turn, undergoes decomposition with evolution of hydrocyanic acid.

The concluding paper "*On the Determination of Urea by Means of Hypobromite*," by Dr. M. SIMPSON and Mr. C. O'KEEFFE, gives a description of a form of apparatus devised by them, of which it would be very difficult to give an intelligible account without reproducing the drawing which accompanies it. It does not seem to be so convenient for hospital practice, however, as that recently described by Dr. Dupré.

The meeting was then adjourned until Thursday, the 29th March, the Anniversary. The next ordinary meeting will be on Thursday 5th April, when Professor Nevil Story Maskelyne will deliver a lecture "On the Discrimination of Crystals by their Optical Characters."

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

March 12th, 1877.

Prof. A. W. Hofmann, F.R.S., Vice-President, in the Chair.

At the opening of the session Prof. Hofmann paid a short tribute to the memory of Frederick Varrentrapp, whose death at Brunswick, in his sixty-second year, has lately been announced. Varrentrapp rendered his chief services to chemistry in his younger years, and his name is best known as associated with that of Liebig's in extensive researches on the fatty series, and with that of Will in the familiar apparatus for the determination of nitrogen in organic bodies. Of late years he had devoted himself almost exclusively to industrial chemistry.

Prof. Oppenheim delivered an address upon the late Brussels Exhibition of Life-saving Apparatus, &c., in its chemical connections.

Prof. Liebermann and F. Giessel described "*Some Derivatives of Chinizarin*." The preparation from phenol chloride and phthalic anhydride has been found to yield the best results. By the action of hydriodic acid and phosphorus as reducing agents chinizarin,—

$$C_6H_4\begin{Bmatrix}CO\\CO\end{Bmatrix}C_6H_2(OH)_2,$$

gave as the first product—

$$C_6H_4\begin{Bmatrix}C(OH)H\\C(OH)H\end{Bmatrix}C_6H_2(OH)_2,$$

crystallising in the form of yellow needles, dissolving in alkalies with a yellow colour, and capable of being changed back to chinizarin by simple exposure to the oxidising effect of the air. The second product is—

$$C_6H_4\begin{Bmatrix}C(OH)H\\CH_2\end{Bmatrix}C_6H_2(OH),$$

also consisting of yellow needles, and the third and final product—

$$C_6H_4\begin{Bmatrix}CH_2\\CH_2\end{Bmatrix}C_6H_2(OH)_2,$$

which is obtained pure in the form of the potassium salt, possesses a slightly acid reaction, and shows all the properties of a phenol. Although not entering into combination with ammonia, it dissolves easily in ethylamin, forming—

$$C_6H_4\begin{Bmatrix}CH_2\\CH_2\end{Bmatrix}C_6H_2\begin{Bmatrix}N(C_2H_5)H\\OH\end{Bmatrix}$$

which separates out in the form of yellow needles. Oxidation changes it into—

$$C_6H_4\begin{Bmatrix}CH_2\\CH_2\end{Bmatrix}C_6H_2{<}\begin{matrix}O\\O\end{matrix}{>}O.$$

A. Michael and T. H. Norton described a new acid, "*Diamido-sulpho-benzide-dicarbonic acid*,"

$$SO_2{<}\begin{matrix}C_6H_4{<}\begin{matrix}NH_2\\COOH\end{matrix}\\C_6H_4{<}\begin{matrix}COOH\\NH_2\end{matrix}\end{matrix}$$

obtained by the action of weak fuming sulphuric acid upon paramido-benzoic acid at 170°. It does not melt below 350°, and crystallises easily from water, but is not easily soluble in alcohol, ether, and other solvents. It forms with sulphuric acid a very soluble compound, and yields finely crystallising metallic salts, those with lead and silver being especially insoluble. This is the first sulphon containing a carboxyl group, which has been so far prepared, and was obtained under very nearly the same conditions by which metamido-benzoic acid yields a sulphonic acid. The authors found in the preparation of para-amido-benzoic acid, from para-nitro-toluen, that a very dilute solution of potassium permanganate was much better adapted for purposes of oxidation than the methods hitherto in use. During the process of reduction with tin and hydrochloric acid it was also observed that paramido-benzoic acid, when heated with $SnCl_2$ at 120°, was entirely decomposed into carbonic acid and aniline.

A. Michael and A. Adair gave the results of experiments on the formation of "*Aromatic Sulphons*," leading to the adoption of the following as a general method of preparation. If sulphonic acid be mixed with an excess of an aromatic hydrocarbon and phosphoric andydride, and heated in a closed tube for a number of hours at 150° to 200°, the corresponding sulphon is formed, although in not very large quantities. Experiments were tried with benzen-sulphonic acid and toluen, para-toluen-sulphonic acid and toluen, and para-toluen-sulphonic acid and benzen. The mixed sulphons of benzen and naphthalin obtained in this way were studied more particularly. Benzen-sulphonic acid and naphthalin yield two isomeric sulphons with the formula—

$$SO_2{<}\begin{matrix}C_6H_5\\C_{10}H_7\end{matrix}.$$

The *a*-sulphon melts at 100°, and forms white rhomboidal crystals. The *β*-sulphon separated from the other by treatment with alcoholic ether melts at 115°, and crystallises in needles. Benzen and *β*-naphthalin-sulphonic acid yield a single sulphon, coinciding in properties with the *β*-sulphon from benzen-sulphonic acid. The isomers are both very insoluble in water. The identity of the compounds obtained by the two processes furnishes additional strength to the theoretical considerations with regard to the hexavalence of sulphur in sulphuric acid.

W. Klobukowski communicated the results of experiments "*On the Constitution of Rufigallic Acid*." An acetyl compound was prepared, and shown by analysis to be a hexacetyl-rufigallic acid. By treatment with methyl iodide and ethyl iodide in the presence of potassic hydrate at 130° tetra-methyl and tetra-ethyl derivatives of rufigallic acid were obtained, which, upon further treatment with the iodides, were changed into the hexa compounds. All of these derivatives possess remarkably fine crystalline forms. They are regarded by the author as proofs of the existence of six hydroxyl groups in rufigallic acid, and as this acid, as well as the compounds obtained by him from it, yield anthracen directly by reduction with zinc, he considers it to be a hexa-oxy-anthraquinon. The formation from gallic acid would then be as follows:—

$$2C_6H_2(OH)_3COOH = 2H_2O + OC[C_6H(OH)_3]_2CO.$$

The following papers have been communicated by non-resident members:—

H. Limpricht, "*Replacement of* Br *and* SO_3H *by* H *in the Benzen-sulphonic Acids*." The author has studied various reactions adapted for the reduction of the more highly substituted benzen derivatives to simpler forms, with the view of controlling their proposed rational formulæ. Concentrated HCl and phosphorus are found to be the best reagents for the gradual replacement of bromine by hydrogen in such compounds. Amido-benzen-sulphonic acid, $C_6H.Br_3.NH_2.SO_3H$, subjected to this treatment for several hours at 140° yields a mixture of $C_6H_2.Br_2.NH_2.SO_3H$, $C_6H_3Br.NH_2.SO_3H$, and—

$$C_6H_4.NH_2.SO_3H.$$

The methods hitherto in use have produced an entire reduction, and have not permitted a study of the possible intermediate products. In most substituted benzen-sulphonic acids SO_3H can be replaced by H simply by heating with concentrated HCl, the bromo-benzen-sulphonic acids being changed into bromo-benzens, the brom-amido-benzen-sulphonic acids into bromo-anilines, &c.

H. Bahlmann has prepared a number of "*Derivatives of Ortho-amido-benzen-sulphonic Acid*." Among these are the mono- bromo- and dibrom-amido-benzen-sulphonic acids, and the orthiodo-, orthochloro-, and ortho-bromo-benzen-sulphonic acids. From the latter a nitro-bromo-benzen-sulphonic acid, $C_6H_3.NO_2.Br.SO_3H$ (1, 4, 5), was obtained by treatment with HNO_3. A number of salts and the amido-bromo-benzen-sulphonic acid obtained by reduction with tin and HCl are described.

B. Radziszewski, "*On some Phosphorescent Organic Bodies.*" Grape-sugar, when dissolved in an alcoholic solution of caustic potash and submitted to the action of a stream of oxygen, exhibits the same phenomenon of phosphorescence shown by lophin, paraldehyd, furfurin, and other polymeric aldehyds or NH_3 derivatives of aldehyds, when exposed to oxidising influences under the same circumstances. This fact furnishes additional proof for the aldehyd nature of grape-sugar. Formic aldehyd exhibits also phosphorescence under similar conditions while changing into formic acid.

A. Baeyer, "*On Furfurol.*" The author has obtained previously among the condensation products of furfurol and various phenols, green substances strongly resembling chlorophyll. Experiments show that the colour is not due to the presence of an aromatic group, as furfuric alcohol itself gives the colouration when treated with HCl. In pursuing the subject furfurol was treated according to Perkin's reaction, with acetic anhydride and sodium acetate. The result was furfuracrylic acid :—

$$C_4H_3O.CHO + CH_3.CO.OH = \\ = C_4H_3O.CH.CH.COOH + H_2O.$$

The new acid, which is isomeric with salicylic acid, melts at 135°, possesses a cinnamonic odour, and is volatile. Concentrated HCl dissolves it under formation of a stable green colour, and H_2SO_4 yields a green condensation product. Reduction with sodium amalgam yields furfurpropionic acid, $C_7H_8O_3$, melting at 50°, forming with HCl a reddish yellow solution, possessing the odour of furfuracrylic acid, but much more soluble in water.

W. Weith, in the course of experiments "*On the Constitution of Carbo-triphenyl-triamine,*" finds that the following is the only decomposition resulting from treatment with HCl or HKO :—

$$CN_3H_2(C_6H_5)_3 + 2H_2O = CO_2 + 3C_6H_5NH_2,$$

that H_2SO_4 neither gives the bright blue colour peculiar to bodies containing $N(C_6H_5)_2$, nor forms diphenyl-aminsulphonic acid, yielding instead sulphanilic acid, that carbo-triphenyl-triamine is not changed under any circumstances to α-triphenyl-guanidin, and that it finally by distillation is decomposed into aniline, ammonia, hydrocyanic acid, diphenylamin, and benzonitrile. From these facts he regards carbo-triphenyl-triamine as a symmetrical triphenyl-guanidin—

$$\begin{matrix} NHC_6H_5 \\ CNC_6H_5 \\ NHC_6H_5 \end{matrix}$$

C. Böttinger, "*Action of Ammonia and Amido-Derivatives upon Pyroracemic Acid.*" Alcoholic ammonia yields a new acid, $C_8H_9NO_4$, which has been named uvitoninic acid. By the action of anthranilic acid upon pyroracemic acid a mixture of condensation products was obtained.

E. Mulder, "*On the Mono-molecular Unit of Volume for Gases and Vapours.*" The author favours from various theoretical considerations the adoption of 0·5 as the atomic weight of hydrogen, in order to give more simplicity to the expression for Avogadro's law, replacing $M = 2\delta$ by $M = \delta$.

H. W. Vogel, "*Spectroscopic Notes.*" The author has discovered that thin sections of garnets yield quite distinct absorption spectra, consisting of a broad band in the green portion of the spectrum, between *b* and F, a less prominent one between D and E, and a weak one between E and *b*. Ruby displays a single band between E and D. It is suggested that this property be made use of for the detection of the precious stones. In order to remove the alkaline bands apparent in the spectrum of purpurin when dissolved in pure water before proceeding to test for magnesia, the addition of a few drops of chloride of ammonium is found sufficient. The use of potassic tartrate for the precipitation of lime from solutions to be tested for Mg is regarded unfavourably on account of the frequent presence of Mg in the tartrate; precipitation with ammonium chloride and carbonate is preferred. In order to test for aluminium by the purpurin reaction, when iron salts are present, the latter are oxidised, the solution is treated with KSCN, and the ferric sulphocyanide thus formed is removed by shaking with ether.

K. Stuckenberg, "*On Benzoyl Derivatives of Ortho-para-amido-phenol.*" The hydrochlorate of this α-diamido-phenol when treated with benzoyl-chloride, yields tribenzoyl-α-diamido-phenol—

$$C_6H_3.N(CO.C_6H_5)_2.NH(CO.C_6H_5).OH,$$

and dibenzoyl-α-diamido-phenol,—

$$C_6H_3.(NH.CO.C_6H_5)_2.OH.$$

The latter crystallises in triclinic columns, which show all the peculiar properties of felspar in polarised light.

"*On α-Amido-nitro-phenol, its Benzoyl Derivative, and an Amido-dinitro-phenol.*" The author obtains α-amido-nitro-phenol from α-dinitro-phenol by subjecting the alcoholic solution to the action of H_2S and NH_4SH. By treatment with benzoyl-chloride benzoyl-α-amido-nitro-phenol was obtained, and from this by the action of HNO_3 the author prepared nitro-benzoyl-α-amido-nitro-phenol, $C_6H_2.(NO_2)_2.NH(CO.C_6H_5).OH$, which, by reduction, gives an amido-dinitro-phenol,—

$$C_6H_2.(NO_2)_2.NH_2.OH,$$

apparently identical with picraminic acid.

"*On β-diamido-Phenol, its Benzoyl Derivatives, and β-amido-nitro-phenol.*" β-diamido-phenol results from the reduction of diortho-nitro-phenol with Sn and HCl. Treatment with benzoyl-chloride yields a mixture of dibenzoyl, tribenzoyl, and tetrabenzoyl-β-diamido-phenol. β-amido-nitro-phenol is obtained from β-dinitro-phenol by the action of H_2S and NH_4SH.

NOTICES OF BOOKS.

Disinfection in Yellow Fever, as practised at New Orleans in the Years 1870 to 1875 inclusive. By C. B. White, M.D. New Orleans: Maddon.

Amongst the epidemics recognised by modern medical science, yellow fever—ravaging as it does almost all parts of the world endowed with a genial climate—holds a very prominent place, and any proved method of checking its spread merits careful attention. It appears tolerably well established that the poisonous agent of this disease is not gaseous in its nature, but attaches itself to the soil, to walls, and surfaces in general. "If this poisonous cause be organisms, either animal or vegetable, they seem to be low-lying, propagating from centres along surfaces equally in all directions, against the wind as well as in the direction of the air-currents." The speed with which the infection travels has been observed to be about 40 feet per day. If, therefore, we take the number of days that a patient has been sick, add four for the number of days of "incubation," and multiply the sum by 40, we shall have the radius in feet of the area which is probably or possibly infected. Under such circumstances disinfection is obviously much more practicable than in case of a gaseous or volatile poison. The agent selected has been the mixture of carbolic and cresylic acids, preferably in the crude state; and it is very satisfactory to learn that, when properly applied, this disinfectant has proved successful in limiting the spread of the pestilence. It will be understood, however, that no half-measures can be satisfactory. The tarry acids must be applied liberally and thoroughly, and even more widely than theory would seem to indicate. The cases described in this pamphlet are exceedingly interesting, and certainly support the author's views. Sulphurous acid and chlorine, used of course separately, have also been found serviceable.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JANUARY, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 ft. tot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Anhydride Sulphuric	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·001	0·007	0·120	0·135	18·90	7·390	0·288	0·87	2·060	13·2	3·8
West Middlesex	Slightly turbid	0·000	0·008	0·150	0·133	18·40	7·560	0·252	0·94	1·860	13·2	3·8
Southwark and Vauxhall	Slightly turbid	0·001	0·006	0·105	0·138	19·00	7·500	0·252	0·87	1·730	13·2	3·8
Chelsea	Slightly turbid	0·007	0·009	0·150	0·120	18·80	7·160	0·180	0·94	1·860	13·2	2·9
Lambeth	Slightly turbid	0·006	0·009	0·210	0·094	20·90	8·170	0·504	1·01	2·260	14·8	4·2
Other Companies.												
Kent	Slightly turbid	0·000	0·003	0·300	0·003	27·90	11·200	0·432	1·51	3·460	20·6	6·0
New River	Slightly turbid	0·000	0·006	0·216	0·094	20·50	8·560	0·216	0·87	1·530	14·9	3·3
East London	Slightly turbid	0·001	0·008	0·150	0·079	22·70	8·230	0·468	1·01	2·460	14·9	3·3

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

CORRESPONDENCE.

ESTIMATION OF UREA.

To the Editor of the Chemical News.

SIR,—My answer to Mr. Apjohn's letter in the CHEMICAL NEWS, vol. xxxv., p. 114, is simple, but more than sufficient. Let Mr. Apjohn read my paper when it appears, and he will find that in this case he has not followed the old adage which teaches us not to cry out before we are hurt.—I am, &c.,

A. DUPRÉ.

estminster Hospital, March 19, 1877.

OXIDISING ACTION OF ANIMAL CHARCOAL UPON ORGANIC MATTERS.

To the Editor of the Chemical News.

SIR,—In answer to the interesting note published in the CHEMICAL NEWS, vol. xxxv., p. 114, by Mr. Robert F. Smith, I have not made any analyses of the mixture of prussiate-char and night-soil either when freshly mixed or afterwards, but undoubtedly a large proportion of the ammonia produced would be lost by evaporation into the atmosphere. The points which Mr. Smith suggests would form an interesting subject of investigation, but no reliable results could have been obtained from such an immense heap of such varied organic matters as the one from which I collected the sample of drainage.—I am &c.,

WILLIAM THOMSON.

Royal Institution, Manchester, March 20, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 9, February 26, 1877.

Effects of a Jet of Air in Water, and on the Suspension of Water in Air: Suspension and Ebullition of Water on a Tissue with Wide Meshes.—M. F. de Romilly.—This paper requires the aid of the accompanying engravings.

Functions of the Leaves in the Phenomena of Gaseous Interchange between Plants and the Atmosphere; Part Played by the Stomata.—M. A. Merget.—It is concluded that the gases tried, however different in their properties, are diffused through the orifices of the stomata with an equal facility in both directions.

Fourth Note on the Theory of the Radiometer.—Extract from a letter of Mr. W. Crookes to M. Th. du Moncel.—The *Comptes Rendus*, January 5, 1877, contains a note by MM. Bertin and Garbe, in which it is said that I have opposed the views of Dr. Schuster regarding the nature of the force producing the movement of the radiometer. So far from opposing Dr. Schuster's views, my experiment "On the Movement of the Glass Case of a Radiometer," described to the Royal Society on March 30, 1876, fully corroborates his experiments. In a communication I had the honour of presenting to the Academy of Sciences on December 11, 1876, I brought forward experimental proof that the presence of residual gas is the cause of the movement of the radiometer, and generally of the repulsion resulting from radiation, the maximum effect being at a pressure of about 50-millionths of an atmosphere. As I have stated in a postscript to my papers, read before the Royal Society more than twelve months ago, and which are now being published in the *Philosophical Transactions*, the explanation afforded by the dynamic theory of gases shows very clearly how it was that I obtained such strong actions in my earlier experiments when using white pith as the material to be repelled, and employing the finger as a source of heat, and how it happened that I did not discover for some time that dark heat and the luminous rays were essentially different in their actions on black and white surfaces. The explanation of this is as follows:—Rays of high intensity (light) pass through the walls of the glass vessel without warming it; they then, falling on the white surface, are simply reflected off again; but falling on the black surface they are absorbed, and, raising its temperature, produce the molecular disturbance which causes motion. Rays of low intensity (dark heat) do not, however, pass through the glass to any great extent, but are absorbed and raise its temperature. This warmed spot of glass now becomes the repelling body

through the intervention of the molecules rebounding from it with a greater velocity than that at which they struck it. The molecular pressure, therefore, in this case streams from the inner surface of the warm spot of glass on which the heat rays have fallen, and repels whatever happens to be in front of it, quite irrespective of the colours of its surface.

Action of Water upon the Chlorides of Iodine.—M. P. Schützenberger.—If the chlorides of iodine are not decomposed into hydrochloric acid, iodic acid, and free iodine, it is because the direction of the reaction is modified by the existence of a compound of hydrochloric acid and of protochloride of iodine permanent in presence of water.

Formation of Quinons by means of Chloro-chromic Acid.—M. A. Etard.—Nitro-quinon, $C_6H_3(NO_2)O_2$, has been obtained by causing 1 part of chloro-chromic acid to react upon 3 parts of benzol, placed in a flask fitted with an ascending refrigerator. The reaction is complete when hydrochloric acid no longer escapes.

Saccharine Matter Extracted from the Leaves of the Nut Tree.—MM. Tanret and Villiers.—Nucite is represented by the formula $C_{12}H_{12}O_{12}+2H_2O_2$.

Salts of the Algerian Salt Marshes.—These salts contain chloride of sodium and sulphate of soda.

Experiments on Acute Poisoning by Sulphate of Copper.—MM. Feltz and Ritter.—An account of experiments performed on frogs, pigeons, rabbits, and dogs, which in this country would be pronounced an "orgie of diabolism." The authors conclude that sulphate of copper will not be willingly taken in quantities sufficient to cause death.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 2, January 11, 1877.

M. Maiche, in the preparation of rice-starch, makes use of a centrifugal machine, by which the water, the starch, and the cellulose are respectively separated from each other.

The Radiometer.—J. Delsaulx.—The author regards the radiometer, not as a thermic, but as a thermo-electric apparatus.

No. 3, January 18, 1877.

M. Littré is taken gravely to task for having, in his great dictionary of the French language, spelt "granit" without the final "e," "in imitation of the English and the Germans." The writer is mistaken as regards the English orthography of the word.

No. 4, January 25, 1877.

This issue does not contain any chemical matter.

NOTES AND QUERIES.

Products of Rosin Distillation.—Could any of your readers give me information on the above, saying the quantities of the two oils obtained from rosin on the manufacturing scale, and also state what are the uses of these oils?—ROSIN.

MEETINGS FOR THE WEEK.

MONDAY, 26th.—London Institution, 5.
—— Medical, 8.
—— Society of Arts, 8. (Cantor Lectures). "Chemistry of Gas Manufacture," A. Vernon Harcourt, F.R.S.
—— Royal Geographical, 8.30.
TUESDAY, 27th.—Civil Engineers, 8.
—— Anthropological Institute, 8
—— Society of Arts, 8. (African Section). "The Best Trade Route to the Lake Regions of Central Africa," by Edward Hutchinson.
THURSDAY, 29th.—London Institution, 7.
—— Chemical, 8. (Anniversary).

TO CORRESPONDENTS.

A Long Subscriber.—Every aniline dye requires different treatment to get it in solution.

A Reader.—The McLeod gauge is described in the *Philosophical Magazine* for 1874, page 110. Mr. Gimingham's improvements in the Sprengel pump are described in *Proceedings of the Royal Society*, vol. xxv., p. 396.

P. Casamajor.—Received with thanks.

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VOL. XXXV. No. 905.

ESTIMATION OF PHOSPHORIC ACID IN PRESENCE OF SILICIC ACID.

By R. W. ATKINSON.

IN the July number of the *Journal of the Chemical Society*, ii., p. 115, 1877, there appeared a short abstract of a paper by E. H. Jenkins (*Journ. Prak. Chem.* [2], xiii., 237—239) which stated that the presence of silicic acid does not interfere with the determination of phosphoric acid by means of ammonic nitro-molybdate, and that it is therefore unnecessary to remove it. As this seemed contrary to all experience, and thinking that it ought to be confirmed or corrected, I requested two of my students to make some estimations of phosphoric acid by this process in presence of different weights of silicic acid, and also in its absence. The following are the results:—

25 c.c. of a solution of sodic phosphate containing 0·025 grm. P_2O_5 were employed in each experiment. Ammonic nitro-molybdate was added, the liquid allowed to stand for eighteen hours, the precipitate washed, dissolved in ammonia, filtered, magnesia mixture added to the filtrate, and the precipitate weighed as magnesic pyro-phosphate. The silicic acid was in the form of sodic silicate.

First Series, by Mr. Watanabe.

	$Mg_2P_2O_7$.		P_2O_5.
1. No silica	0·0390 grm.	=	0·0249 grm.
2. No silica	0·0395 ,,	=	0·0253 ,,
3. 0·3935 grm. SiO_2	0·0455 ,,	=	0·0291 ,,
4. 0·7870 ,,	0·0505 ,,	=	0·0323 ,,
5. 1·1805 ,,	0·0555 ,,	=	0·0355 ,,

Second Series, by Mr. Takamats.

1. No silica	0·0392 grm.	=	0·0251 ,,
2. 0·223 grm. SiO_2	0·0409 ,,	=	0·0262 ,,
3. 0·553 ,,	0·0429 ,,	=	0·0274 ,,
4. 1·106 ,,	0·0451 ,,	=	0·0288 ,,

In both series it will be observed that the weight of the magnesic pyro-phosphate increases with the amount of silicic acid present, and therefore the apparent amount of phosphoric acid increases likewise. Although there is not a perfect agreement between the two sets of experiments as to the increase in weight of the magnesian precipitate for a given weight of silicic acid present in the solution, still, I think, it is sufficient to show that the silica ought to be completely removed before estimating the phosphoric acid. I trust you will oblige me by giving publicity to this correction.

University of Tokio, Japan,
February 7, 1877.

ON THE DIFFERENCE IN QUALITY OF SOME SAMPLES OF SO-CALLED PURE SODIUM ACID SULPHITE.

By W. F. K. STOCK, F.C.S.

SOME time ago I received a supply of sodium acid sulphite, which was labelled "Pure for Analysis," and in using it for the reduction of acid solutions of ferric salts in the separation of phosphoric acid, I found that after neutralising with sodium carbonate the reduced solution, the addition of sodium acetate produced a precipitate which, though light red at first, became deeper and deeper upon boiling, until it had acquired a dirty olive-grey tint. This led to a suspicion of the presence of sulphur compounds of lower oxidation in the acid sulphite, and the salt was examined and found to contain hyposulphite.

In order to ascertain whether the occurrence of this impurity was the result of accident, I lately procured from six of the best known laboratory furnishers a small quantity of their pure acid sodium sulphite, as sold for the reduction of ferric salts in the "volumetric estimation of iron." Upon the arrival of the samples, they differed considerably in appearance, and ranged in colour from pale straw to white. The percentage quantity of matter insoluble in water was very small in each case, ranging from 0·14 to 0·06. When tested for hyposulphite only one sample was found to be free; it was from Messrs. Townson and Mercer. For the others, no two specimens were alike in the quantity contained; there was, moreover, a very wide difference between the potential of reduction of the best sample and the worst. When tried upon solutions of ferric chloride of known strength under exactly similar conditions, 40 parts of the best sample were equal in power to 100 of the worst. Now it seems to me that when a certain salt is sold as *pure* and fit for analytical work, some effort ought to be made by the firm selling the substance to ensure its being as near as possible the article it professes to be; because often in an active laboratory there is little time to spare for more than the application of a few simple tests to ascertain the comparative purity of reagents, and very considerable reliance is often—too often in fact—placed upon the name and fame of the firm supplying the material, and again it is especially necessary that the chemical reagents supplied to those who are struggling with the difficulties of a chemical education should really be pure in nature as well as in name. Imagine the embarrassment of a student on finding a coloured precipitate formed in a solution of say copper, arsenic, and ferric iron by the use of "pure" sodium acid sulphite, which he had added for the sole purpose, and with the one expected result of simply lowering the condition of the arsenic and iron previous to passing H_2S. It is difficult to conceive how the variation here dealt with occurs, for the methods of preparation of the "bisulphite" seem to be held within very narrow limits; it is a question, however, which deserves an answer, and I hope shortly to be able to communicate further with you upon this subject. Meanwhile I must apologise for the meagre character of this note, and claim indulgence for it solely upon the ground that there is good in everything which tends to equalise the conditions under which similar work is performed by different analysts.

A DEFENCE OF TURNER'S METHOD OF DETECTING BORACIC ACID.*

By C. LE NEVE FOSTER, B.A., D.SC., F.G.S.

A DEFENCE of Turner's method† seems at first sight to be quite unnecessary, for his test has been used over and over again, for upwards of fifty years, and, as far as I am aware, its usefulness has never been questioned till quite lately. Great was my surprise a few days ago to read a paragraph "On the uselessness of Turner's flux as applied to the Detection of Boracic Acid."‡ Professor Chapman speaking of Turner's method, says:—"This test is much quoted in blowpipe books, and works on chemical analysis generally; but it is altogether superfluous. With borate of soda it fails entirely, or yields very unsatisfactory results; and although it answers for

* A paper read before the Mineralogical Society, December 18th, 1876.

† It consists in heating on Pt wire before the blowpipe the powdered mineral mixed with a flux made of 4½ parts of bisulphate of potash, and one part of finely powdered fluor spar. If boric acid is present the flame is coloured green.

‡ On some Blowpipe-Reactions, by Prof. E. J. Chapman. *Canadian Journal*, October, 1876.

most other borates, and for borosilicates, it is uselessly applied to them, because these bodies colour the flame equally well *per se*." He quotes from Buzengeiger (*Annales des Mines*, 1829, tome v., p. 36), in support of these statements.

Surely, I said to myself on reading the article, the careful Plattner and my good friend and most painstaking teacher, Prof. Theodor Richter, would never have recommended Turner's method if they had not been convinced of its value. Besides, I have so often used the test myself with such marked results that I feel quite satisfied that it is a useful one.

However, to fortify my conviction, and make quite sure that I have not been labouring under an optical delusion for the last seventeen years, I have lately made a series of tests, and I am glad to say that the reliance I have always placed on Turner's test does not appear to be unfounded.

My first experiments were made with a view to combat Prof. Chapman's assertion that "with borate of soda it (Turner's test) fails entirely, or yields very unsatisfactory results."

I suppose in speaking of "borate of soda," he refers to borax, and not to the neutral borate.

I first prepared some mixtures of borax and orthoclase, and then another series of borax and common salt. Some of the experiments were as follows:—

1. Borax mixed with three times its volume of Turner's flux, heated on Pt wire in flame of Bunsen burner, imparts a very decided green colour to the flame.

2. Mixture of ninety-seven parts by weight of orthoclase and three parts of borax, treated with flux in the same way. Distinct green coloration.

3. Mixture of equal parts by weight of borax and common salt, treated with flux in the same way. Decided green flame.

4. Mixture of nine parts by weight of common salt and one part of borax, treated as before. Flame plainly coloured green.

5. Mixture of ninety-eight parts by weight of common salt and two parts of borax, treated as before. By holding the Pt wire close to the flame of the Bunsen burner, without quite touching it, I managed to tinge the edge of the flame a distinct green.

6. Mixture of ninety-nine parts by weight of common salt and one part of borax, treated as before. By very carefully approaching the assay to the flame, I obtained a decided green coloration.

As is well-known, the green coloration does not last long, but it is very plain and characteristic.

The facts which I have just brought forward are surely sufficient proof of the delicacy of Turner's test, even in the presence of large quantities of sodium. In mixture No. 6 I only had 1 per cent. of borax, or about $\frac{1}{2}$ per cent. of boric acid (B_2O_3), and yet I succeeded in obtaining a distinct reaction.

In all the above experiments I used a Bunsen burner, but as Prof. Chapman speaks of testing with the blowpipe flame, I tried several of my mixtures in that manner.

With No. 6 I failed to obtain a satisfactory coloration, but Nos. 4 and 5 gave a decided green. I need hardly say that to prevent any possibility of error on my part, I tested my Turner's flux alone and mixed with salt, and in neither case did I see any green tinge. Before using a piece of Pt wire, I invariably tried it in the Bunsen flame alone, and with Turner's flux, so as to make sure of its being perfectly clean.

Prof. Chapman's second assertion, that most of the borates (save sodic borate) and boro-silicates colour the flame equally well *per se*, as when mixed with Turner's flux, does not at all agree with the results that I have obtained on various occasions.

I made some comparative tests as follows:—I pulverised some schorl and made part of the powder into a paste with water, and mixed the rest with Turner's flux. I then tested the two on Pt wires simultaneously, at the opposite sides of the flame of the same Bunsen burner. The schorl alone gave at most a greenish yellow coloration, whilst when mixed with the flux, the green tinge, though evanescent, was very vivid.

Axinite treated *per se* before the blowpipe, in a darkened room, gives, it is true, a yellowish green colour to the flame, but the colour obtained by the use of Turner's flux is *to my eyes* far greener and more intense.

Axinite *per se* in the flame of the Bunsen burner does not give such decided results as in the blowpipe flame, but with Turner's flux I had not the slightest difficulty in securing a marked green coloration.

Such being the results of my experiments, I am almost at a loss to account for Prof. Chapman's statements. Two solutions of the difficulty may be suggested.

1. Prof. Chapman does not apply the test in exactly the same manner as I do. Having carefully prepared Turner's flux in accordance with Plattner's directions,* I invariably thoroughly incorporated 3 volumes of the flux with 1 volume of the finely pulverised mineral by *grinding the two together* in an agate mortar. I sometimes make the mixture into paste with water, and plaster it on to the loop of the Pt wire, or else heat the Pt wire, and dip it into mixture. On holding the assay at the tip of the blue flame before the blowpipe, or in the flame of the spirit lamp, or Bunsen burner, a vivid green colour appears, if boric acid is present, but, as said before, the coloration lasts but a short time.

2. It is possible that the colour afforded by fluo-boric acid does not produce the same effect on the eyes of Prof. Chapman as it does upon those of most people. Berzelius himself was well aware of the fact that two persons do not always apply the same name to a certain colour. "For instance," he says, "Gahn would call a tint yellow or dark yellow which I should have called red, although we both agreed in the case of the pure primary colour, whether yellow or red."† This will, perhaps, explain to Prof. Chapman why Berzelius says nothing about the coloration afforded by certain minerals when treated before the blowpipe. It does not follow that he "overlooked the coloration of the flame," but knowing that some of his observations differed from those of his master, Gahn, he may have thought it better to omit the impressions produced on his eyes by certain flames, fearing that they would not agree with those produced on other people.

Of course, I do not for a moment impugn the accuracy of Prof. Chapman's results as far as he is individually concerned, but I still think that by the majority of blowpipe workers, or "pyrologists," as my friend Major Ross dubs us, Turner's test will be found to be eminently satisfactory.

A NEW METHOD OF DETERMINING WITH ACCURACY THE MELTING-POINTS OF METALS AND OF OTHER SUBSTANCES BAD CONDUCTORS OF HEAT.‡

By Dr. HIMLY.

A KNOWLEDGE of the boiling points of liquids under the same atmospheric pressure has the same high value as a means of distinguishing them from each other as crystalline form has in the case of solid bodies. These constitute distinguishing physical characteristics in both cases; indeed, in cases of liquids, their purity is determined by the constancy of the boiling-point, of course excepting those liquids which are decomposed in the act of evapo-

* Plattner's "Probirkunst mit dem Lothrohre," 4te Auflage, 1865, p. 466.

† Translated from Berzelius's *Anwendung des Lothrohrs*, Nurnberg, 1821, p. 79.

‡ Translated from *Poggendorff's Annalen* (Feb., 1877), by a Member of the Physical Society.

ration. As regards the temperature of the boiling-point, certain physical conditions have been discovered as dependent on this, especially in the case of substances belonging to organic chemistry. How is it, however, as regards the temperature of the melting-point. Here we must admit that the connection between the temperature of the melting-point and the physical constitution of the body is still wholly unknown to us. The importance of a knowledge of the melting-points is evident, if we only take into consideration the number of organic bodies whose melting-points are constant (when pure). How little we know of the connection between the molecular constitution of the body and its melting-point, may be illustrated by merely referring to the elementary substances. Why, for example, do platinum and iridium only melt at the highest temperature of the oxyhydrogen flame, while mercury is already liquid at 39° C. below the freezing point?

The melting-points of other metals lie between these extremes, but the varying densities of the metals give us no insight into this. To follow this inquiry further would lead too far from our present purpose. I will only put one more question:—What physical condition determines the fact that the metal calcium melts already at a red heat, while when united to oxygen (a gas so volatile as to be incapable of liquefaction), it is as infusible as carbon.

The number of melting-points reliably determined, whether in the case of simple or compound bodies, is (in proportion to the vast number of bodies) extremely small, and yet it will be only possible to deduce laws regarding the physical conditions which determine the melting-points, after a large number of these melting-points have been accurately observed. Under these circumstances, I think therefore I am doing a service to science if I make known a method for determining the melting-points which is easily applied and affects a remarkable accuracy, and is applicable equally to good and bad conductors of heat, such as metals, fats, &c.

In *Dingler's Polyt. Journal* (vol. 201, p.250), a very interesting method of determining the melting-points of organic substances which are non-conductors of electricity is described by J. Löwe. This method consists in coating a platinum wire with a layer of the substance whose melting-point is to be determined. The platinum wire dips into a bath of mercury, which latter is connected with an electric bell, a galvanic cell being placed in the circuit. So long as the coating of substance on the platinum wire remains unmelted the bell remains silent. The bath of mercury is gradually heated, the coating of substance melts, and the wire makes contact with mercury, and thus closes the electric circuit. The bell rings, and at that instant the temperature is read off by a thermometer placed in the bath of mercury. The difficulty of determining with accuracy the melting-points of substances which are bad conductors of heat, such as fats, &c. (especially when they possess a considerable latent heat) is well known, as also the imperfection of the method hitherto employed for this purpose, which consisted in placing the substances to be examined in capillary tubes, and in observing an approximated thermometer as soon as the melting began. On account of this difficulty, the ingenious method devised by M. Löwe was all the more to be welcomed. It is to be regretted, however, that the experiments made by a former scholar of mine, C. H. Wolff (and described in the *Archiv. d. Pharmacie*, vol. 3, 1875) have shown that the degree of accuracy expected was not attained, as, for example, in the case of a piece of white wax, M. Wolff obtained, in a series of twenty-four experiments results varying between 61·2° C. and 65·4° C., or a difference of 4·2° C. This circumstance caused him to diminish the thickness of the platinum wire, and to alter its form, by which means he says that, after many experiments, he reduced the difference to only 0·5° C. That with this method absolute accuracy was unattainable is no doubt to be ascribed to the difference in the conducting power for heat possessed by the platinum of the wire and the mercury of the thermometer.

Induced by the fact that the Royal Dockyard of Wilhelmshaven, besides requiring exact quantitative analysis of different white metals (of which, remarkably enough, two specimens contained about 5 per cent. of mercury), also required exact determinations of the melting-points of the same, I have for this purpose employed a method which has only that in common with M. Löwe, in possessing the arrangement of an electric bell. The object to be attained was not only to avoid the errors above alluded to in the determination of the melting-points of bad conductors of electricity and heat, but also to render the method applicable to the determination of the melting-points of substances which are good conductors of electricity and heat. This new method is as follows:—

The glass mercurial thermometers employed are made with thin ogival-shaped bulbs, and the bulbs (and also part of the tube) are chemically coated with silver. As the silver coating is very easily damaged, it is well to strengthen it with a coating of copper in the ordinary way by means of a weak galvanic current and a solution of sulphate of copper. Before this, however, a fine annealed copper wire is to be wound round the thermometer tube a little above the bulb. The wire is then to be laid along the side of the thermometer tube and fastened to it by an india-rubber band, to avoid all jerks on the wire, as the latter is afterwards to be connected with a galvanic cell. The coating of copper is allowed to extend above the point where the wire is attached, by which means a better metallic contact is ensured. For the determination of the melting-points of metals, or alloys and good conductors of electricity, the copper coating may be somewhat thicker for the sake of durability, while in the case of investigations with non-conductors, the copper coating should be thin, or may be dispensed with altogether. It remains now to describe the special method of procedure.

Determination of the Melting-Points of Metals and Good Conductors.—For this purpose a U-shaped tube with arms about 10 centimetres long is required, the glass of which, for the sake of durability, should not be too thin. The arms should be parallel and close to each other. The bore of the tube should not be much larger than the bulb of the thermometer employed.

The metal or alloy to be experimented upon is to be cast in the form of small bars, about the same thickness as the bulb of the thermometer. Besides this, an iron bowl or crucible is wanted, which can be slowly heated by means of a spirit-lamp or gas burner. According to the height of the melting-point to be determined, the crucible is to be filled with mercury or some fusible alloy. To carry out the experiment, the thermometer with its attached wire is to be placed in one arm of the U-tube, and the small bar of metal to be tested in the other. The bar should be pushed in quite up to the bend, so that the bar and the bulb of the thermometer are as near together as possible without touching. A conducting wire reaching down to the bend of the tube is placed by the side of the metal bar, the wire being of such a length as to admit of being conveniently connected with a galvanic element. The whole arrangement with the U-tube is attached to a convenient support with clamp, so that the U-tube can be immersed in the bath of mercury or melted alloy.

An electric bell (with galvanic element) is inserted in the circuit between the two wires attached to the thermometer bulb and metal bar respectively. The complete circuit is therefore only broken at the bend of the U-tube, and as long as this interruption lasts, the bell is silent When, however, the heating of the metallic bath in which the U-tube is immersed has gone so far that the metal bar in the tube melts, then the melted metal closes the electric circuit. At the same instant the bell rings, and the reading of the thermometer is taken. When it is considered that the thermometer and the metal bar are

exposed under perfectly similar conditions to the source of heat, the accuracy of the melting point thus determined must be self-evident. This method of experimenting is of course only to substances which are conductors of electricity, and whose melting points are such as to permit the use of a mercurial thermometer. This principle would also be applicable to metals with high melting-points, provided the U-tube were made of some refractory material, and a suitable pyrometer substituted for the thermometer.

Determination of the Melting-Points of Substances, Non-conductors of Electricity and Heat.—For this investigation also the metallically-coated thermometer with conducting wire attached, is employed. The substances to be examined are first melted, and just when solidification begins again to set in at the sides of the containing vessel, the metallically-coated bulb of the thermometer is dipped for an instant into the substance. In this way the bulb of the thermometer is coated with the substance to be examined. It suffices if the coating be from one to two millimetres thick. Further, an iron crucible is required with a hole formed in the lid. In this hole a thin porcelain crucible filled with mercury is placed, which dips well into the liquid in the iron crucible. The liquid in the iron crucible may consist of glycerin, or a solution of chloride of calcium in glycerin, which may be heated to a temperature of 200° C. without giving any trouble. If higher temperatures are required, then it would be well to use a bath of liquid alloy or mercury.

The carrying out of the experiment is very simple. After the bulb of the thermometer (and a small part of its tube) has been coated in the manner described with the substance to be examined, and the whole has become cool again, then the thermometer is immersed in the mercury of the porcelain crucible. The wire attached to the silvered coating of the thermometer, and a wire dipping in the mercury are then respectively to be connected to the circuit containing the galvanic element and bell. Then the glycerin bath is to be slowly heated.

Since now the substance whose melting-point is to be determined is in actual contact with the bulb of the thermometer itself, it is clear that at the instant of melting (when the bell rings), the thermometer must give the temperature with wonderful accuracy. This is in itself so evident that it is not necessary to refer for illustration to the number of experiments which have been made.

It may just be added in conclusion that in measuring the melting-points of metals or alloys, the level of the metal bar to be tested should be completely below the level of the melted substance in the heating bath, and the bath should be heated uniformly, *i.e.*, not only underneath, but at the sides. The uniform heating of the bath may be best attained by stirring its contents with a small iron bar; also it is well to take care that the U-tube is not irregularly bent, so that there is no unevenness in the bend of the tube to obstruct the free downward flow of the metal from the melted bar.

CONTRIBUTIONS TO VOLUMETRIC ANALYSIS.*

Second Paper.—On a New Mounted Burette.

By P. CASAMAJOR.

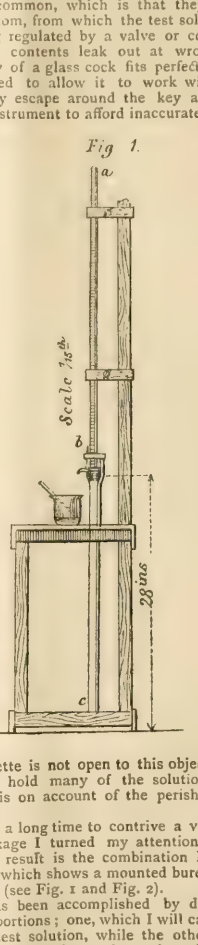
At the last meeting of this Society I described and exhibited a new burette of the portable class. This evening I will solicit your attention to another new burette of the class called mounted or permanent.

* Read before the American Chemical Society, December 7, 1876.

Note.—Since reading this paper before the American Chemical Society, I have found that in the essential characteristics of this burette I had been anticipated. In the new work by E. J. Maumené, *Traité Théorique et Pratique de la Fabrication du Sucre*, vol. ii., p. 482, is a woodcut, accompanied by a description, of a burette, in which the liquid is displaced by a plunger, and it drops out from a small beak at the top of the outer tube. The burette is attributed to E. J. Maumené, the preface of whose book bears the date: Paris, Septembre, 1876.—P. C.

Burettes of this class have many advantages over portable instruments. For one thing they can be made much longer, so that, for the same degree of minuteness in their scales, they are able to hold much larger quantities of liquid, and consequently do not require to be replenished so often. They are also less liable to breakage than portable instruments, as they are firmly held in a stand and are not so subject to accidents from handling. Instruments of this class have, however, a serious defect in common, which is that they have an opening at the bottom, from which the test solutions run out, the flow being regulated by a valve or cock, which generally lets the contents leak out at wrong times. Even when the key of a glass cock fits perfectly, if it is sufficiently loosened to allow it to work with nicety, enough liquid may escape around the key and remain adhering to the instrument to afford inaccurate results.

Fig 1.



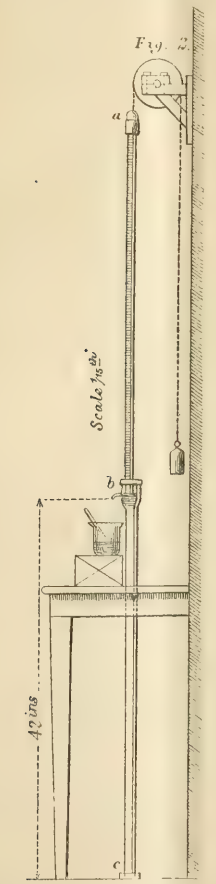
Dr. Mohr's burette is not open to this objection, but it is ill adapted to hold many of the solutions used in volumetric analysis on account of the perishable nature of its rubber tube.

After trying for a long time to contrive a valve or cock not liable to leakage I turned my attention in another direction, and the result is the combination I present to you this evening, which shows a mounted burette without a valve or a cock (see Fig. 1 and Fig. 2).

This result has been accomplished by dividing the burette into two portions; one, which I will call the outer tube, holds the test solution, while the other, which is the inner tube or plunger, bears the graduated scale. As this latter portion sinks into the outer tube it displaces a certain volume of liquid, which finds its way out through the little beak c (Fig. 3).

The plunger tube, being a plain cylinder, has nothing in its shape that deserves attention. It is not so, how-

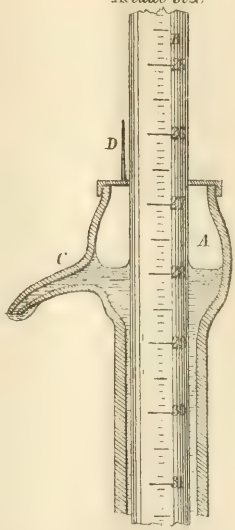
ever, with the outer tube, whose upper portion is expanded and provided with a beak. This portion is represented in Fig. 3, in which A is the outer tube, B the plunger, C the beak, belonging to the outer tube, and D the index. In this figure I have endeavoured to give every detail that is necessary to obtain single drops when the plunger is properly lowered. The object of enlarging the upper portion of the outer tube is to prevent any variation in the surface of the liquid. If the outer tube was not made larger at this part the plunger tube, as it



moved down, would not keep equally distant from every portion of the inner surface of the outer tube. Whenever the distances varied the shape of the surface of liquid would vary also, rising as the sides of the tubes drew nearer together. The consequence of this would be that for a downward movement of the plunger, sufficient to afford a drop, sometimes no liquid would fall, and at other times, several drops would fall in succession. By widening the upper portion of the outer tube, the surface of the liquid remains the same for all positions of the plunger.

The shape taken by the liquid at the top of the outer tube is represented in Fig. 3. We may notice that the surface of the liquid, between the plunger and the outer tube, forms a ring, the liquid rising slightly as it touches the glass surfaces. At the end of the beak there always remains a small particle of liquid, which ought to spread partly on the under surface of the beak, as shown in Fig. 3. The liquid with an annular surface between the two tubes, that which fills the beak, and the small portion adhering to the end of the beak, form altogether a system whose equilibrium is very easily disturbed. When the inner tube is pushed down sufficiently, so that the additional volume that enters in the liquid is equal to about $\frac{1}{10}$ of a cubic centimetre, the small volume of liquid at the end of the beak increases perceptibly and a drop escapes. Unless the beak is so small as to remain entirely full of liquid

Fig. 3.
Actual Size.



and unless the end of the beak is such that a small volume of liquid adheres to it exteriorly, delicacy of equilibrium cannot be obtained, and the burette will not respond with readiness and regularity to very small downward motions of the plunger.

As glass tubes are not made cylindrical but slightly conical, an accurate graduation could not be obtained by taking the whole volume of a tube between two points, situated near its extremities, and dividing the space equally into cubic centimetres. The best plan is to divide a long tube into several equal portions, each representing a known number of cubic centimetres, and afterwards sub-divide each portion into centimetres and fractional parts. The plunger of this burette was divided into portions of 10 c.c., and each such portion was subdivided into centimetres and tenths. To effect this the first step was to take a long and narrow test-tube, which was gauged by placing in it 10 c.c. of water, and marking the surface of the liquid on the side of the tube. This tube, after being emptied and dried with bibulous paper

was ready for use. The outer tube of the burette, being filled with water so that a portion drops out of the beak, the plunger, with its bottom closed but its top still open, is lowered gradually until a few drops have started again from the beak. This is the starting point which is marked on the plunger opposite to index, which may very conveniently be placed on a cap covering the outer tube (see D, Fig 3). The mark on the tube may be made with a file, previously moistened with spirits of turpentine or petroleum, to prevent the abrasion from cracking the glass. In the next place the test-tube, capable of holding 10 c.c. is placed under the beak, and the plunger is lowered until the test-tube is filled up to the mark designating 10 c.c. Another mark is then made on the plunger tube as before, and the operation is repeated until the bottom of the plunger touches the bottom of the outer tube. After every volume of 10 c.c. has been measured, the test-tube is dried with bibulous paper to get it ready for the next measure. When the operation is ended, the result is a series of marks on the plunger, between which its outside dimensions are equal to 10 c.c. Now a long and narrow strip of paper is taken, and the distances between the marks on the plunger are transferred with a compass on the paper. After this each space is divided into 10 equal parts, which are again sub-divided into 10 equal parts, the smaller divisions representing tenths of cubic centimetres.

The next step is to introduce the paper scale into the plunger tube, which was found to be a difficult operation, as the strip of paper would not go in straight on account of its great length. The difficulty was overcome by pasting the strip of paper to the outside of a glass tube, whose diameter was small enough to allow it to slip easily into the plunger tube. A little wad of paper or cotton should be placed in the plunger tube before introducing the tube bearing the scale, to prevent a sudden shock from cracking the tubes.

The scale should be placed on the narrower tube in such a way that, when lowered in its place, the divisions of the paper scale corresponding to 0, 10 c.c., 20 c.c., &c., may be found opposite to the file marks on the plunger tube. Afterwards the top of the plunger tube is closed by melting over a lamp.

In Fig. 1 and Fig. 2 are shown two manners of mounting the burette. In Fig. 1 the height from the beak to the bottom of the outer tube is 28 inches, and the instrument may be placed either on the floor or on a table. In the first, the operator must be seated, while, in the second case, he must stand, so that in every case his eye may be placed opposite to the index. The plunger tube, in Fig. 1 is held by two clamps.

In Fig. 2 the distance between the beak and the bottom of the outer tube is 42 inches. The outer tube reaches to the floor, and it may be protected by a case of wood or metal. The plunger is attached to a flexible band or belt, free from torsion, so that the scale will always remain in front of the index. The belt passes over a pulley attached to the wall of the laboratory, and the other end of the belt bears a weight to counterbalance the plunger tube. The operator must be seated when using this instrument. A burette of greater length may be made on the same plan by running the outer tube to the floor, and making it high enough to place the index opposite to the eye of the operator when standing.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

March 17th, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

MR. W. S. SEATON was elected a member of the Society.

MR. SPOTTISWOODE exhibited some experiments on the stratification of the electric discharge in vacuum tubes, and described his attempts to produce the effects as obtained by Mr. Gassiot and Mr. De la Rue, with batteries of several thousand cells by means of the induction coil. He showed the different forms of striæ produced in several different gases, and mentioned that the side towards the negative is always sharply defined, and that towards the positive gradually shades off into darkness. Mr. Spottiswoode has examined them by means of a rotating mirror, the mercury break being worked by the axis of the mirror so that the one only varies with the other. It was thus clearly ascertainable whether a band was progressing towards either pole or remaining stationary, or was intermittent, according as the line observed in the mirror was inclined or horizontal or broken. He considers that the ordinary break prolongs the sparks, so as, in some cases, to give rise to the ill-defined nature of the striæ, and he showed two forms of contact breaker adapted to these experiments. In the first the breaking was effected by a steel rod caused to vibrate by an electro-magnet, the number of these vibrations being determined by the musical note produced. In the apparatus now usually employed, however, a brass wheel is caused to rotate with great rapidity, the tops of the teeth are covered with platinum, the spaces between them being filled in with ebony. It was shown that if the current be made and broken by a wire resting on the rim of this wheel, the bands may be caused to move in one direction or the other, or remain stationary according to the velocity of rotation of the wheel. A very ingenious arrangement, invented by Mr. Spottiswoode's assistant, Mr. Ward, was employed for introducing resistance into the secondary circuit, and thereby adjusting the strength of the current to suit the velocity of rotation of the wheel. It consisted of a spiral column of mercury surmounted by a vessel containing a badly conducting liquid, and by raising or lowering a cup connected with the base by means of an india-rubber tube, the amount of mercury present in the column is increased or decreased, the resistance offered by the column of constant length of course varying in the inverse proportion.

Capt. ABNEY, R.E., then read a paper on the photographic image, prefacing it by a brief account of the two theories, the chemical and the physical, which are held regarding it. On the former a molecule of bromide of silver is split up into sub-bromide and bromine, the latter of which is absorbed; and, on the latter theory, light acts mechanically on the molecule shifting the positions of the atoms. Poitevin has done much to confirm the former of these by placing a film of silver iodide in contact with a silver plate, when he succeeded in obtaining an image both on the film of iodide and on the silver plate, produced by the liberated iodine. Capt. Abney has performed the following experiment:—A portion of a dry plate, which had been exposed was wet with a sensitive collodion emulsion of bromide of silver and developed by the alkaline method; the films were separated from the glass and from each other by means of gelatinised paper, and were found to bear images; and the same result was obtained when the emulsion was added after exposure, development, and fixing. These experiments entirely disprove the supposition that only those molecules acted on by light are reduced. If the two films be separated by a thick layer of albumen, the lower picture develops as a negative and the upper as a positive. Capt. Abney is now engaged in an attempt to determine the attraction exercised by the sub-bromide, and this, it is hoped, will do much towards the complete solution of the problem of the photographic image.

Mr. O. J. LODGE proposed a modification of Mance's method for determining the intensity of an electric current. This method, of which Wheatstone's bridge is an application, depends upon the fact that if three conductors be united at a point A, and their extremities B C and D be united by three wires B C, C D, D B, the resistance of B C will be independent of that of A D if A B is to A C as B D is to C D. In the arrangement proposed by Mr. Lodge four wires are joined in the form of a square, and

the circuit can be completed across one diagonal by means of a key, and in the other diagonal is included a condenser and a galvanometer with a long fine wire. The greatest sensitiveness is obtained when the resistances in the four sides are equal. A great advantage of this method consists in the fact that it is equally applicable to the measurement of small and great resistances. Mr. Lodge then showed a modified form of Daniell's cell, capable of giving a constant current for a considerable period. A glass cell, half filled with dilute sulphuric acid, contains two vertical glass tubes, one of which, open at both ends, is traversed by a zinc rod, while the other is closed at its lower end, and contains cupric sulphate, from which rises a copper wire. The portion of the copper tube projecting above the acid is sufficiently moist to enable the current to traverse its surface, while the zinc sulphate is prevented from reacting on the copper.

NOTICES OF BOOKS.

Directions for the Use of the Aniline Colours in Dyeing Leather. By M. W. Eitner, Director of the Imperial Laboratory.

The author recommends, for leather-dyeing, the aniline colours prepared by the Berlin Aniline Dye and Colour Company, which are specially arranged to suit the requirements of this trade. The preparatory operations required present no novel features, it being merely requisite that the leather should be perfectly clean, those intended for light shades being of course washed for a much longer time than those destined to receive dark colours."

For the production of so-called "Russian red"—formerly obtained with the red woods, along with a solution of tin and the occasional addition of alum or of tartar—the "Juchtenrath" or "leather-red" is recommended. It is produced in three shades—G, light; G R, medium; and R, dark. The colour required is simply dissolved in 100 parts of clean, soft, boiling water, condensed steam-water being very suitable. The solution thus obtained is left to settle for two to three hours, and the clear liquid is then taken in greater or less quantity, according to the size of the pair of skins to be treated, diluted with warm water, and is then ready for use. It is not desirable to use a concentrated bath at the outset. The first pair of skins is therefore dipped at the beginning in a very dilute bath. They are then taken through a second and a third, each stronger than the foregoing. The second pair of skins is dipped in the second of the baths already used, then in the third, and lastly in a new bath as strong as the third before it had been used. Thus each bath is used three times, and each pair of skins is passed through two old baths and one new one. In this manner the colour is thoroughly used up, and an even shade is obtained on the skins, which, if entered at once in a strong dye-bath, would take the colour irregularly and become cloudy. When dyed, the skins are plunged in pure cold water, rinsed, placed on the stretcher, and slightly oiled. If birch-oil is used, for the sake of the peculiar odour of Russian leather which it imparts, care must be taken that no free acid is present, as always happens if the oil has been sophisticated with wood-tar; it must be carefully neutralised with carbonate of soda. The dyed leather should be rapidly dried in a room specially fitted up, as the aniline colours can endure higher temperatures than shades obtained from the woods. For moistening the leather for the subsequent finishing operations very dilute solutions of "G" may be used.

A fourth shade, GG, gives a yellower red. Another, "Red S," gives the cochineal shades, especially pink. In the use of this dye the bath must be made as hot as the leather can bear. An addition of saffron (? safflower, or saffranin) decoction, as in the treatment with cochineal dyes, enhances the brilliancy of the colour.

Most yellow dyes derived from coal-tar produce dark spots on such portions of the grain-side of the leather as have been scratched or scraped. Certain colours, however, prepared by the Berlin Company are free from this defect. Phosphine-orange gives the "brightest and most intensely yellow of the yellowish brown shades, commonly termed almond-yellow." It requires 500 parts of water for solution, and must be boiled till no residue remains. The liquid is then ready for use at once without dilution. If a less fiery shade is wanted, treatment with a solution of bichromate of potash lessens the vividness of the dye.

For a gold-orange colour the Philadelphia yellow of the same Company is recommended, dissolved in 300 parts of water.

A redder shade is produced by "Berlin brown G," which is well fitted for reddening the darker shades produced with the dye-woods.

A pure orange may be obtained with "corallin" dissolved in 150 parts of water. It must be dyed and afterwards dried as rapidly as possible, as it has a tendency to fade.

A "half-dark subdued blue" is produced with "marine blue" dissolved in 300 parts of water. The skins must *not* be previously passed through dilute sulphuric acid.

For a pure light blue "water-blue B B" is taken, and for redder shades "water-blue R."

Dark blues were formerly obtained by the use of a red dye-ware over a vatted ground. The result is better obtained by grounding in "water-blue R" and topping with "nigrosin" dissolved in 300 parts of boiling water. Nigrosin applied directly to leather dyes uneven shades.

"Methyl-green" is much used for topping skins which have been dyed green with extract of indigo and fustic. All sulphuric acid must first be carefully washed away.

"Methyl violet" can be successfully used even on the worst skins.

The "B" variety yields blue shades, and the "R" produces red shades. The colour is dissolved in boiling water, but may be used cold.

CORRESPONDENCE.

CORRECTION FOR WEIGHING IN A VACUUM.

To the Editor of the Chemical News.

Sir,—Being interested in the errors introduced into chemical analysis by weighings conducted at different atmospheric pressures, I was led to study the literature of the subject, and in doing so I came across what appears to me a curious mistake, or, at all events, a statement which, looked at from whatever point of view I may, I cannot understand. In the Chemical News (vol. xxix., p. 20) there is a short paper by Charles W. Folkard, entitled, "Limits of Accuracy Attainable in Ordinary Weighing," in which the author considers the difference in the weight of a platinum dish when weighed against brass weights on the first occasion with the bar. at 760 m.m., and on the second when the bar. has fallen 12·5 m.m. The considerations involved are stated as follows:—"So the bulk of air displaced by the weights is 10·7 c.c., one-third of this being compensated for by the volume displaced by the platinum; consequently the remaining two-thirds only are to be considered:—$10{\cdot}7 \text{ c.c.} \times \frac{2}{3} = 7{\cdot}13$ c.c. . . . . Now, the 7·13 c.c. of air weigh 0·00922 grm. (at 760 m.m.), and by this diminution of pressure (12·5 m.m.) will weigh 0·00015 grm. less. Therefore, the weights being buoyed up by 0·00015 grm. less, the dish will apparently weigh $1\frac{1}{2}$-tenths of a milligramme more than before." It is this last statement which creates the difficulty in my mind, for, if the weights at the second weighing are buoyed up by 0·00015 grm. less than at the first weighing the end of the beam to which they are attached will fall, and, in order to

bring about equilibrium, some of the weights will have to be removed; consequently the platinum dish will appear to weigh 0·00015 grm. *less* at the second weighing, and not more, as stated by Mr. Folkard.

I have the same difficulty in comprehending Mr. Crookes, in the paper read before the Royal Society "Researches on the Atomic Weight of Thallium," contained in the same vol. of the CHEM. NEWS, p. 29.

I have thought it better to put the matter to the test of experiment, and as I cannot conveniently weigh at pressures varying considerably from one another, it appeared to me that I should be fulfilling the necessary conditions, if for the rarer atmosphere I employed air at the ordinary pressure, and for the dense atmosphere water. The results would of course be exaggerated, but that would be rather an advantage than otherwise. The scale pans of a balance having been removed, a piece of glass rod was attached by means of a hair to one end of the beam, and counterpoised with platinum wire similarly attached to the other end. Beakers of water were brought under the platinum wire and glass rod, and raised, so that these bodies were immersed. On unlocking the beam the end to which the platinum wire was attached was depressed, so that, in order to bring about equilibrium, some of the wire had to be removed; and I should express this result by saying, that the glass at the second weighing (in water) appeared lighter than at the first weighing (in air). This experiment was intended to be representative of the case considered by Mr. Crookes, and it appears to me to support my own view.

I am somewhat diffident in bringing this matter forward, as the probability of the two gentlemen mentioned making a mistake of this kind is rather small, and I can scarcely believe that they have done so, but as I have given the subject some little consideration, and being unable to comprehend it as stated, I feel justified in laying the matter before your readers in the hope that, if wrong, one of them will kindly set me right.—I am, &c.,

T. C. CLOUD, A.R.S.M.

Laboratory, Wallaroo Smelting Works, S. Australia,
January 20th, 1877.

[The subject is fully explained in Mr. Crookes's paper. The writer can also consult with advantage Prof. W. H. Miller's paper "On the Construction of the New Imperial Standard Pounds," in the *Phil. Trans.* for 1856, part 3.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 10, March 5, 1877.

Temperatures of Combustion.—M. Berthelot.—Not capable of useful abstraction.

Method of Extracting Platinum from the Chloroplatinates.—M. E. Duvillier.—The author for this purpose takes advantage of the property of the salts of platinum of being reduced by alkaline formiates at the boiling-point in presence of alkalies.

Physical and Mechanical Actions Exerted by the Incandescent and Strongly Compressed Gases from the Combustion of Gunpowder. Application of these Facts to Certain Characters of Meteorites.—M. Daubrée.—Gases strongly compressed act differently according as they are completely imprisoned or as they escape with great speed in a given direction. In this latter case their hot particles follow each other in a very brief part of time upon each part of the body which is exposed to their friction and their destructive action. They accumulate their heat upon it so as to produce fusion, and they carry off mechanically the metal as soon as melted in the state of an impalpable powder. In this condition the metal combines rapidly with sulphur.

Isomerism of the Rotatory Power in Camphols.—M. J. de Montgolfier. The author finds that the rotatory power $+37°$ of natural and of artificial borneol is absolutely identical.

An Aniline-Black Vat, and on the Conversion of Aniline-Black into a Fluorescent Rose Colouring Matter.—M. Goppelsroeder.—The base of electrolytic aniline-black dissolves in fuming sulphuric acid. The solution, if poured into water, forms a green precipitate, which, on washing with water, dissolves with a green colour. This solution dyes wool green, is turned blue by alkalies, and is rendered green again by acids. It is decolourised by the hydrosulphites, as also by zinc in presence of acids, and is again turned green by a few drops of fuming nitric acid. It is decolourised by sodium amalgam, and is turned by the hypochlorites first to a blue-violet, then to a red-violet, and becomes green again on contact with sulphurous acid. An excess of hypochlorite turns it a reddish yellow, which becomes yellow on the application of heat. Chlorine water renders it blue-violet, blue, violet, and lastly vinous red. With sulphate of copper it gives a green precipitate, which, if washed and suspended in water and decomposed by sulphuretted hydrogen, gives a nearly colourless filtrate, becoming green again on exposure to the air, and violet on the addition of chlorine water. The alkaline blue-violet solution of the green precipitate is turned green by an acid, and is subsequently rendered turbid by a green deposit. It becomes a red-violet on the addition of hypochlorites. If heated it is turned orange-red, and even yellow and red-violet by bromine and chlorine, an excess of which, however, decolourises it. Fuming nitric acid turns it green, and on the application of a gentle heat it is decolourised. The blue-violet solution is decolourised by reducing agents. If treated with glucose it becomes a brownish yellow, but is rendered blue again on exposure to the air, and violet-blue if treated with hypochlorites. It is reduced by Schützenberger's hydrosulphite of calcium, as well as by zinc and by the mixture of glycerin, stannite of soda, and soda proposed by M. Prud'homme for the reduction of indigo. Fibres steeped in these vats are coloured on exposure to the air violet, then violet-blue, and blue, shades which are rendered green by acids. The light blue is changed on superoxidation to a grey, and the deep blue to a black. The most varied shades may thus be produced from light grey to black. By saturating the tissue with the solution of the chromogen, this is changed in the air into a colour which remains fixed upon the fibre, and which, upon treatment with an oxidising agent such as the solution of ferric chloride acidulated according to the method of Jeanmaire, is changed to a grey or a black which does not turn green. The fibre may also be alternately steeped in the vat and exposed to the air to superoxidise it, and arrive at a black incapable of "greening." These operations are repeated till the wished-for shade is obtained. The black vat may be associated with the indigo vat, or it may also be used for printing. It will also serve for ink and for marking goods at dye and print works. The base of electrolytic aniline-black has been treated with melting bisulphate of potash; sulphurous acid and nitrogen escape. The fused mass contains neither sulphite, hyposulphite, nor sulphide, and imparts to water a yellow colouration. The residue insoluble in water was treated with hot concentrated sulphuric acid. The solution was poured into water, when an abundant black precipitate was produced. The liquid took a red-violet colour and became fluorescent on the addition of ammonia. The precipitate on treatment with alcohol gave a red colouring matter having the same fluorescence and the same characters, spectroscopic and chemical, as naphthaline-rose. It dyes silk. Along with the rose there is also formed a very small quantity of a violet colouring matter.

Researches on the Acidity of the Human Gastric Juice.—M. Ch. Richet.—The quantity of liquid in the stomach has no influence upon its acidity. Wine and alcohol augment the acidity, but sugar diminishes it. The gastric juice is more acid during digestion than at other times.

Action of Hydrosulphite of Soda on the Hematosin of the Blood.—M. P. Cazeneuve.—On causing hydrosulphite to react upon hematosin (Chevreul), called also hematin by German authors, the following results were obtained:—The hematosin was dissolved in boiled distilled water and rendered alkaline with ammonia, and the solution was then submitted to spectroscopic examination. The characteristic band of the alkaline solutions of hematosin was observed. But on adding one or two drops of hydrosulphite the dichroic tint of the alkaline solution disappeared, and was succeeded by a vermillion-red tint, which might be taken for the colour of a solution of oxyhemoglobin.

A "Fire-damp metre" which may Serve to Determine the Amount of Protocarbide of Hydrogen in a Mine.—M. J. Coquillion.—The author has contrived two forms of his apparatus, the one for use in the mine and the other for laboratory purposes. Both depend on the principles that hydrogen and its gaseous carbides are completely burnt in presence of oxygen and a palladium wire raised to white redness.

Chemical Examination of Turnerite.—M. F. Pisani.—The author finds in this mineral—

Phosphoric acid	28·4
Oxides of cerium and lanthanum.. ..	68·0
	96·4

Les Mondes, Revue Hebdomadaire des Sciences,
No. 5, February 1, 1877.

The Absorption-Radiometer.—M. Thoré.—If the luminous cone from a lens is thrown across a small glass tube, at the bottom of which is placed a pinch of charcoal dust which is gently shaken in order to distribute it in the ambient air, we see the cone defined by the reflection of the light from these particles, but on examining attentively with the aid of a lens magnifying eight or ten times the extremity of this cone, that is to say the place where all the luminous and calorific rays are united, we observe a very curious fact, that all the particles are animated with a very rapid movement of projection parallel to the axis of the cone.

Nos. 6, 7, and 8, February 8, 15, and 22, 1877.

These issues contain no chemical matter.

No. 9, March 1, 1877.

M. Zinno prepares oxygen on the large scale by causing permanganate of potassium to react on binoxide of barium diluted with water.

Carbuncle is traced by M. Koch to the introduction of bacteria into the system by stinging-flies. They obtain the poisonous germs from putrescent carcases.

An explosive has been introduced under the name of pantopollite. It consits of nitroglycerin dissolved in naphthalin. The fumes developed on its explosion are extremely distressing, producing violent pain in the head and chest.

No. 10, March 8, 1877.

M. Cance is said to have constructed an electro-magnet much superior to that of M. Camacho.

A composition for preventing incrustations in steam boilers composed of mashed potatoes, alum, and soda has been devised by MM. H. Beaucourt and Co. It bears the strange name of "Antitartaric Paste," and is recommended by the Abbé Moigno, who remarks: "It will be seen that I have not ceased to be the active centre of progress!"

In the notice of a work on the purification and utilisation of sewage the daring statement is made that in England irrigation has been found the only realisable process.

Cause of the Movement of the Radiometer.—MM. Bertin and Garbe.—These authors repeat the erroneous statement that the results obtained by Mr. Crookes disagreed with those of Dr. Schuster.

No. 11, March 15, 1877.

This issue contains no chemical matter, and is to a great extent taken up with a denunciation of the astronomer Flammarion, an attempt to connect the end of the Turkish Empire with the "Great Pyramid," and a re-investigation of the very inconvenient case of Galileo.

Reimann's Färber Zeitung,
No. 8, 1877.

This issue contains merely receipts.

No. 9, 1877.

Alleged Poisonous Colours.—The Berlin political papers have brought up a case of inflammation of the eyes produced by knitting with red woollen yarn dyed with "nitronaphtholin." Dr. Reimann points out that there is no such colour in existence, and that binitronaphthol, which may possibly be meant, is a yellow, not a red dye, and is never used in producing a red on wool.

No. 10, 1877.

A mordant for Turkey-red is said to have been discovered in France, and to be in use on a large scale.

M. Reimann denies the existence of magenta in red wines, since they invariably contain tannin, which would precipitate the magenta, or any other aniline colour.

No. 11, 1877.

This issue is to a great extent taken up with a controversy between the editor and certain unscientific papers on an alleged case of inflammation of the eyes said to be due to the use of knitting wools dyed with a poisonous colour. Dr. Reimann has decidedly the best of the argument.

MISCELLANEOUS.

Royal Institution of Great Britain.—Lecture arrangements after Easter, 1877:—

Prof. John Hall Gladstone, Ph.D., F.R.S. — Five Lectures on the Chemistry of the Heavenly Bodies; on Tuesdays, April 10 to May 15. Three lectures (lectures and subject undetermined); on Tuesdays, May 22, 29, and June 5.

Prof. Tyndall, D.C.L., L.L.D., F.R.S.—Eight Lectures on Heat; on Thursdays, April 12 to May 31.

Edward Dannreuther, Esq.—Two Lectures on Chopin and Liszt, with many illustrations on the pianoforte; on Saturday, April 14, and Thursday, June 7.

The Rev. Archibald H. Sayce, M.A., Fellow of Queen's College, Oxford.—Three Lectures on Babylonian Literature; on Saturdays, April 21, 28, and May 5.

Walter H. Pollock, Esq., M.A.—Three Lectures on Modern French Poetry: On Saturdays, May 12, 19, 26.

Charles T. Newton, Esq., C.B., Keeper of Greek and Roman Antiquities in the British Museum.—Two Lectures on the Recent Discoveries at Mycenæ; on Saturdays, June 2, 9.

The following are the probable arrangements for the Friday Evening Meetings after Easter, 1877, to which members and their friends only are admitted:—Friday, April 13, William Spottiswoode, Esq. LL.D., Tr. R.S., Sec. R.I., "Experiments with a Great Induction Coil." Friday, April 20, Frederick Pollock, Esq., M.A., "Spinoza." Friday, April 27, Lieut.-Gen. Richard

Strachey, R.E., F.R.S., "The Physical Causes of Indian Famines." Friday, May 4, Rev. W. H. Dallinger, "Researches on the Origin and Development of Minute and Low Forms of Life." Friday, May 11, D. Mackenzie Wallace, Esq., M.A., "The Intellectual Movements and Secret Societies in Russia." Friday, May 18. Friday, May 25, G. J. Romanes, Esq., "The Evolution of Nerves and Nervo-Systems." Friday, June 1, Oscar Browning, Esq., "The History of Education." Friday, June 8, Prof. Tyndall, D.C.L., LL.D., F.R.S.

The Chemical Society's Dinner.—The President, Fellows, and friends of the Chemical Society dined together on the 20th inst. at Willis's Rooms. About 200 were present. After the national toasts had been duly honoured, Professor A. W. Williamson proposed "The Learned Societies," which was responded to by Professor Huxley and Mr. Bramwell, C.E. Professor Odling then proposed "Success to the Chemical Society," which was responded to by the President, Professor Abel.

Fownes's Manual of Chemistry.—Messrs. J. and A. Churchill are issuing a new edition of Fownes's Manual of Chemistry. The rapid development of the science of chemistry having caused a steady increase in the bulk of this work, it has been determined to divide it into two volumes, each complete in itself. The first volume, which is already published, will henceforth be known as "Fownes's Physical and Inorganic Chemistry," the second as "Fownes's Organic Chemistry." The work continues to be under the able editorship of Mr. Henry Watts, F.R.S.

Yorkshire College of Science.—Purchase of Site for Permanent Buildings.—One of the most important steps yet taken by the governing body of this college was decided upon at the last meeting of the council, when it was unanimously resolved to purchase from Mr. John Lawson the Beech Grove Hall estate, containing about 3½ acres of land, at the price of £13,000, as the site of the permanent buildings. Since the meeting, we understand the contract of purchase has been signed. The total donations to the college have now reached the sum of £42,456. The site which has been secured is within a mile of the railway stations, and in proximity to Woodhouse Moor and the Grammar School.

Iron and Steel Institute.—The eighth annual meeting of this Institute was held on the 20th inst. at the Westminster Palace Hotel. The total number of members elected during the year 1876 was 69. The number on the books at the end of December was 946. The autumn meeting of the year 1876 was held at Leeds. At that meeting a communication was received from Sweden inviting the Institute to pay a visit to that country during the summer of 1877. The council were, owing to the death of Mr. David Forbes, compelled to abandon the idea of going to Sweden in 1877. At the meeting in Leeds particular attention was called to the advisability of taking some action for procuring a distribution of a portion of the property held by the Royal Commissioners of the Exhibition of 1851, for the purpose of promoting technical education in the more important of our manufacturing and industrial districts. Since that time the Council have placed themselves in communication with various Science Colleges and Technical Institutions throughout the country, and they have made arrangements to hold a Preliminary Conference between the representatives of these various bodies, with a view of determining upon the course of action that it will be advisable to pursue in connection with this matter. The Council have awarded the Bessemer medal for this year to Dr. John Percy, of the Royal School of Mines. The next Annual Meeting is to be held at Newcastle-on-Tyne. The members met at the rooms of the Institute of Civil Engineers on the 21st and 22nd inst., when an address was delivered by the President, Dr. Siemens, F.R.S., and papers were read by Mr. I. Lowthian Bell, M.P., and Mr. E. Riley, &c.

MEETINGS FOR THE WEEK.

Monday, April 2nd.—Royal Institution, 2. General Monthly Meeting.
Tuesday, 3rd.—Civil Engineers, 8.
—— Photographic, 8.
Wednesday, 4th.—Society of Arts, 8. "The Pioneer Railway," by F. J. Rowan.
—— Microscopical, 8.
—— Pharmaceutical, 8.
Thursday, 5th.—Chemical, 8. "Lecture on the Discrimination of Crystals by their Optical Characters;" experimentally illustrated, by Prof. N. S. Maskelyne, F.R.S.
Friday, 6th.—Geologist's Association, 8.

THE
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13, Dundas Street.
Glasgow, March 22nd, 1877.

BERNERS COLLEGE of CHEMISTRY, in conjunction with the SCIENTIFIC DEPARTMENT of the ROYAL POLYTECHNIC INSTITUTION.

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THE CHEMICAL NEWS.

Vol. XXXV. No. 906.

ALLEGED DISCOVERY OF A NEW METAL.

From a communication made to the *Société des Sciences Physiques et Naturelles de Bordeaux* we learn that M. Prat has discovered a new metal, which, in honour of Lavoisier, he calls Lavœsium. This new metal is of a silvery white colour, malleable and fusible. It forms crystallisable and colourless salts. The following are some of its reactions:—When treated with potassa a hydrated white precipitate is obtained, insoluble in an excess of the precipitant. Ammonia gives a precipitate very soluble in excess. Ferro-cyanide of potassium gives a characteristic precipitate similar to the colour of the petals of *roses du Bengale*. With hydrosulphuric acid a brown colouration is first obtained; the precipitate afterwards changes to a fawn colour. Tannin gives a deep yellow-green precipitate.

In the spectroscope the new metal gives:—1. In the indigo-blue two sets of characteristic lines. 2. In the bright green two other sets of simpler lines, also characteristic. 3. Some blue, violet, and green secondary lines; in all twenty-three lines. These characteristic lines exactly coincide with those of copper, which would seem to show that the new metal contains copper. Its silvery white colour, however, and some of its reactions, especially those with ammonia and ferrocyanide of potassium, constitute properties which distinguish it from any other known metal. According to M. Prat this body is much more common than he at first supposed, it having been found in many minerals, and especially in iron pyrites. If Lavœsium really exists its therapeutic action and its industrial uses remain to be studied.—*Correspondance Scientifique* from *Le Monde Pharmaceutique*.

ON THE RELATIONSHIP OF STRUCTURE, DENSITY, AND CHEMICAL COMPOSITION OF STEEL.*

By Prof. JOHN W. LANGLEY.

At the present day much attention is being given to the importance of studying the connection between the chemical composition and physical properties of matter—meaning by physical properties such characteristics as crystalline form, colour, hardness, specific gravity, &c. The following paper is offered as a slight contribution to this department of knowledge.

There are two methods of investigating this subject: first, to take bodies whose chemical nature is intimately known, and to commence an examination of their physical character; the second, to take material long known and studied from the mechanical side, and to investigate its chemical composition. The latter is the method here followed.

Steel, from its great industrial importance, is the best known of all alloys, and its behaviour under mechanical forces has been most extensively studied, both by individuals and governments; but, unfortunately, the elaborate tables of tensile strength, elasticity, &c., thus produced, have not been supplemented by correspondingly thorough chemical analyses, because it has only very recently been surmised that slight variations in the composition of steel affect its behaviour more radically than do all the processes of the rolling-mill or the machine-shop. Within the last eighteen months the United States have appointed a commission to study in detail the connection between the strength, elasticity, &c., of steel and iron, and their chemical composition as shown by analysis. The research, which is the basis of this paper, was commenced before the organisation of the U. S. Commission; but after the general government decided to take up the subject and to explore it for the benefit of engineers, all that part of the original design was, of course, abandoned, and our attention has been chiefly directed to a study of the chemical and molecular structure of steel—a field which it is probable will not be entered upon by the Government Commission.

In such an undertaking the number of facts to be acquired and of subjects to be pursued in detail is very great; they are thus far in a very incomplete state, and I am therefore able to furnish a record of a portion only of the work done—that which merely serves as a foundation for future research. In March, 1874, Messrs. Miller, Metcalf, and Parkin, steel manufacturers, of Pittsburg, selected eight samples of steel which were believed to form a set of graded specimens, the order being based on the quantity of carbon which they were supposed to contain. They were numbered from one to eight. On analysis the quantity of carbon was found to follow the order of the numbers, while the other elements present—silicon, phosphorus, and sulphur—did not do so. As the method by which these samples were selected has an important bearing on the subject in hand, it will not be out of place to describe it.

The steel is melted in black-lead crucibles capable of holding about 80 lbs.; when thoroughly fluid it is poured into cast-iron moulds, and when cold the top of the ingot is broken off, exposing a freshly-fractured surface whose plane is approximately at right angles to the axis of the ingot. The appearance now presented is that of confused groups of crystals, all appearing to have started from the outside and to have met in the centre: this general form is common to all ingots, of whatever composition, but to the trained eye, and only to one long and critically exercised, a minute but indescribable difference is perceived between varying samples of steel, and this difference is now known to be owing almost wholly to variations in the amount of combined carbon, as the following table will show. This consists of twelve samples selected by the eye alone in April, 1875, and the analyses were made from drillings taken direct from the ingot before it had been heated or hammered.

Table I.

Ingot Nos.	Iron by Diff.	Carbon.	Diff. of Carbon.	Silicon.	Phos.	Sulph.*
1	99·614	0·302	—	0·019	0·047	0·018
2	99·455	0·490	0·188	0·034	0·005	0·016
3	99·363	0·529	0·039	0·043	0·047	0·018
4	99·270	0·649	0·120	0·039	0·030	0·012
5	99·119	0·801	0·152	0·029	0·035	0·016
6	99·086	0·841	0·040	0·039	0·024	0·010
7	99·044	0·867	0·026	0·057	0·014	0·018
8	99·040	0·871	0·004	0·053	0·024	0·012
9	98·900	0·955	0·084	0·059	0·070	0·016
10	98·861	1·005	0·050	0·088	0·034	0·012
11	98·752	1·058	0·053	0·120	0·064	0·006
12	98·834	1·079	0·021	0·039	0·044	0·004
	Mean		0·071			

Here the carbon is seen to increase in quantity in the order of the numbers, while the other elements, with the exception of total iron, bear no relation to the numbers on the samples.

It has long been known that the structure of cast-steel, as visible to the eye, bears some relation to the quantity of carbon present, and a rough classification by this method has been in practical use; but the above analyses

* Read at the Buffalo Meeting of the American Association for the Advancement of Science.

* The determinations of sulphur were made by Pro A. R. Leeds, of Hoboken, N. J.

Table II.

Specific Gravities of Twelve Samples of Steel from the Ingot; also of Six Hammered Bars, each bar being over-heated at one end and cold at the other, in this state plunged into water, and then broken into pieces of equal length.

	1.	2.	3.	4	5.	6.	7.	8.	9.	10.	11.	12.
Ingot	7·855	7·836	7·841	7·829	7·838	7·821	7·819	7·818	7·813	7·807	7·803	7·805
BAR.												
Order of samples from bar —												
Burned 1	—	—	7·818	7·791	—	7·789	—	7·752	—	7·744	—	7·690
2	—	—	7·814	7·811	—	7·784	—	7·755	—	7·749	—	7·741
3	—	—	7·823	7·830	—	7·780	—	7·758	—	7·755	—	7·769
4	—	—	7·826	7·849	—	7·808	—	7·773	—	7·789	—	7·798
5	—	—	7·831	7·806	—	7·812	—	7·790	—	7·812	—	7·811
Cold 6	—	—	7·844	7·824	—	7·829	—	7·825	—	7·826	—	7·825

The temperature to which the densities are referred is 60° F.

show a very close connection between composition and structure, for differences of carbon so slight as seven-hundredths of one per cent will impress such a change in the crystalline appearance of the metal that the eye of the expert can detect it, rarely ever making a mistake when the total carbon rises to a half per cent or more. In mild steels the discrimination is less perfect.

The appearance of the fracture by which the above twelve selections were made can only be seen in the cold ingot before any operation, except the original one of casting, has been performed upon it. As soon as it is hammered the structure changes in a most remarkable manner, so that all trace of the primitive condition *appears* to be lost; but although the crystalline form thus seems to be destroyed by heat or pressure, it can again be rendered evident by a special mode of treatment.

Another method of rendering visible to the eye the molecular and chemical changes which go on in steel is by the process of hardening or tempering. When the metal is heated and plunged into water it acquires, as every one knows, an increase of hardness, but also suffers a loss of ductility. If the heat to which the steel is raised just before plunging is too high, the metal acquires intense hardness, but it is so brittle as to be worthless; the fracture is of a bright, granular, or sandy character. In this state it is said to be *burned*, and it cannot again be restored to its former strength and ductility by annealing; it is ruined for all practical purposes, but it is in just this state that it again shows differences of structure corresponding with its content in carbon. The general nature of these changes induced by heat and tempering are sufficiently marked to be visible to an untrained eye, and can be illustrated by plunging a bar, highly heated at one end and cold at the other, into water, and then breaking it off in pieces of equal length, when the fractures will be found to show appearances characteristic of the temperature to which the sample was raised.

The great molecular changes thus rendered evident are probably accompanied by changes of a chemical character between the iron and the carbon. According to Caron such combinations do really occur, but the subject has thus far been too little investigated to warrant any decided expression of opinion.

There is a physical property which is well known to be intimately connected with chemical structure, viz., density, and in the case of union between gases it has risen to be sometimes even the criterion of combination. The specific gravity of steel and iron has been taken many thousand times before this, but not usually in conjunction with analysis; it is believed that a study of the densities of a series of steels under varied conditions, and as a sequel to analytic work, would develop facts of interest. Accordingly, samples were taken from the above twelve ingots by boring out a piece with a crown drill, breaking off the core left by the tool, and then grinding and polishing the surface smooth; also six bars drawn from the ingot were heated to *burning* at one end and were left cold at the other, then plunged into water, thus forming sets like the fractures just alluded to; each bar was then broken into six pieces and the ends rendered smooth, so that the specific gravity could be taken.

In the table above the results are given: the upper horizontal line contains the numbers belonging to the ingots; the left-hand vertical column gives the order of the pieces broken from the bars.

It is thus seen that the density decreases with the increase of carbon up to No. 5, which contains eight-tenths of 1 per cent of carbon; below this number the influence of various physical conditions—such as the rapidity of cooling, degree of fluidity before casting, &c.—influence the specific gravity in an apparently erratic manner, though the numbers still continue to vary inversely as the carbon in a general sense; also if the influence of temperature on density is noted with regard to the sets of hardened samples, it will be seen that, taking the numbers from 12 to 6 (or those containing the highest amount of carbon), the specific gravity is lower the higher the temperature applied. Finally, the lowest horizontal line shows the densities of the metal as it left the hammer, and the upper horizontal ones belonging to the bars the expansion produced by over-heating. By the influence of hammering, all the pieces have been brought to nearly the same density, but as soon as the *burning* point is reached the steel is brought back nearly to the condition which it had at the moment of casting, and now the specific gravity is seen to vary in the same sense as the numbers in the ingot line above it.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Thursday, March 29th, 1877.

Professor Abel, F.R.S., President, in the Chair.

At this meeting the President delivered his annual address, giving an account of the progress and present state of the Society, from which it appears that the increase during the past year has only been 35, making the total number of Fellows 919. The losses by death have been 16:—T. Charlesworth, F. C. Devigne, H. Deacon, Paul de la Rue, David Forbes, A. Harvey, J. Hearder, F. H. Hobler, A. S. Hobson, C. Lambert, L. A. Lucas, M. Lichtenstein, G. Parry, Alfred Smee, F. Smith, and T. H. Wyndham, besides one foreign member, M. Balard, the distinguished discoverer of bromine. Seven foreign members have been elected, namely, Professors Bæyer, Boutlerow, Cooke, Friedel, Heintz, and Thomsen. The number of communications brought before the Society last year was 70, being more than in any previous year, besides two lectures, the one "On Certain Methods of Physico-Chemical Research," by Professor Andrews, and the other "On the Theory of the Bunsen Flame," by Professor Thorpe. The fund for the promotion of chemical research has

made very satisfactory progress, and now amounts to more than £3000, including the munificent donation of £1000 by Dr. Longstaff and a like amount given by the Goldsmith's Co. The state of the ordinary income of the Society, however, is much less favourable, owing to the small increase in the number of Fellows as compared with former years, being less than half what it was last year, and less also than in any of the four previous years. There is but little doubt that the cause of this very serious falling off is to be ascribed not only to the blackballing which has been taking place for some time past, but the effect which certain instances of manifestly unjust exclusion by this means has had in deterring candidates from offering themselves for election. This system of blackballing is pursued by a small section of those Fellows who regularly attend the meetings, as is evident from the fact that the number of black balls does not exceed eight or nine; as, however, one-fourth negative balls suffices to exclude a candidate, this ensures the blackballing of the candidate unless the attendance of Fellows is numerous at the commencement of the meeting. It was to be hoped, however, that the injurious effects of their mode of action, which is most seriously imperilling the future prosperity of the Society, would induce them to give the matter their serious consideration. The President then gave an account of the negociations which had taken place between the Council and the Committee for organisation amongst professional chemists, which had since developed into the "Institute of Professional Chemists," and noticed the alteration which had been made in the Fellows' certificate for election, and the reasons which had induced the Council to propose the alterations in the bye-laws, which were to be submitted to them that evening.

The Treasurer then read his Report, Messrs. Carteighe, Friswell, and Nicholson being auditors.

Mr. E. Neison said he would like to draw the attention of the Fellows to two or three matters before the adoption of the President's Report was moved, and then pointed out (1) that, although the general index to the Society's *Journal* had cost a large sum, £282, comparatively few copies had been sold; he thought it would be advisable to distribute the index gratuitously to the Fellows. (2) He stated that the laboratory was very insufficiently supplied with apparatus and chemicals, and suggested that when the Society granted money to chemists for assisting them in conducting original research they might at the same time place the laboratory at their disposal. (3) That a very long time, three or four months or more, elapsed between the reading of a paper at one of the Society's meetings and its appearance in the *Journal*, and concluded with some remarks on the blackballing which has recently taken place in the Society.

Professor Williamson remarked that it was most important that some appropriate occasion should be offered for the discussion of various matters affecting the welfare of the Society, and was very glad that they now had an opportunity of talking over this matter of the blackballing together. He was very jealous of the privilege or rather duty of the Fellows of excluding those candidates who were not properly qualified, but at the same time this function should be exercised with the greatest discretion. No doubt this action had been taken on some principle, but it was a principle which he did not understand, and if, instead of producing the effect they desired, it had produced others of an unexpected and perhaps disastrous character, he hoped those members who had exercised this privilege would reconsider their mode of action, which, if continued, would produce very serious injury to the well-being of the Society.

Mr. Kingzett made some remarks on the subject of blackballing, and also complained that a paper by Dr. Hake and himself read before the Society in January last had been returned to him by the committee of publication with suggestions that he should make certain alterations in it before it was published in the Society's *Journal*.

Dr. Thudichum made a similar complaint; several of his communications had been treated in the same way. He had addressed a solemn letter to the Council on the subject, but had received no reply.

Dr. Odling said that the management of the affairs of the Society was entrusted to the Council by the Fellows; some of the papers were undoubtedly delayed, but only those papers which the publication committee did not at first see their way to recommend for publication, and which were referred to be specially reported on. Some sort of censorship must be exercised; it would be very unreasonable to ask them to undertake to publish indiscriminately every paper which might be presented. With regard to the blackballing, he quite agreed with Dr. Williamson that it was most important that the privilege should be exercised with the greatest discretion, but in this case it was evident that a small section of the Society, a minority of 8 or 9 members who regularly attended the meetings, were thwarting the wishes of the majority, since one black ball in four was sufficient to reject a candidate.

Mr. E. Riley thought it would be far better to adjourn this discussion and proceed with the business of the evening; he therefore begged to second the motion that the Report of the President be received.

It was moved by Mr. Kingzett as an amendment, and seconded by Dr. Thudichum, that the words "unjust" and "indiscriminate" in the Report as applied to the blackballing be omitted.

The amendment was then put by the President, but only 12 members voted for it out of the crowded meeting; the original motion was then put and carried.

The election of Officers and Council for the ensuing year was then proceeded with, Messrs. Riley, Carteighe, and Neison being appointed scrutators. The following gentlemen were elected:—

President—Dr. J. H. Gladstone.

Vice-Presidents—F. A. Abel, Sir B. C. Brodie, Warren de la Rue, E. Frankland, A. W. Hofmann, W. Odling, L. Playfair, A. W. Williamson, T. Andrews, W. Crookes, F. Field, J. H. Gilbert, H. E. Roscoe, J. Stenhouse.

Secretaries—W. H. Perkin and H. E. Armstrong.

Foreign Secretary—H. Muller.

Treasurer—W. J. Russell.

The other members of Council are J. Attfield, I. Lowthian Bell, A. H. Church, C. E. Groves, W. N. Hartley, C. W. Heaton, T. H. Hills, David Howard, G. Matthey, J. A. Phillips, R. V. Tuson, and C. R. A. Wright.

A vote of thanks to the retiring President, Professor Abel, which was received with acclamation, was proposed by Professor Williamson and seconded by Dr. Warren de la Rue. There were also votes of thanks to the Officers and Council proposed by Mr. Carteighe and seconded by Mr. Tennant; to Mr. Watts and the abstractors by Dr. Odling and Mr. Crookes; and to the Auditors by Dr. Russell and Dr. Paul.

Professor Abel then dissolved the meeting, and resolved it into a special general meeting to consider some alterations in the bye-laws, when the new President, Dr. Gladstone, took the chair.

Mr. Neison proposed some verbal alterations; a discussion arose as to these resolutions being brought forward without notice. Mr. Neison ultimately agreeing to postpone the matter until the next annual meeting.

The following alterations in the bye-laws, proposed by the Council, were then put to the meeting and carried unanimously.

In Paragraph II. of the bye-law relating to associates. (*a*) The words at the commencement of the second paragraph to be—"Associates shall pay an annual subscription of one pound." (*b*) The following words to be added at the termination of the second paragraph—"but they shall have the option of paying an annual subscription of thirty shillings in place of one pound, for which subscription they shall be entitled to a copy of the Society's *Journal*, in addition to the ordinary privileges of Fellows, with the exceptions hereinbefore specified." Also the

new form of obligation to be signed by Fellows on their admission (the words in italics being the additions to the old form).

"I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Chemical Society, *that I will* observe its Laws, and *to the utmost of my power maintain* its dignity, as long as I shall continue a Fellow thereof."

The meeting was then adjourned until Thursday, April 5.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, February 22nd, 1876.

The President in the Chair.

The Secretary read the following papers:—

"*On a Water-Box Deposit*," by J. T. Dunn. This deposit, which I received from Mr. M. Fryer, was formed last autumn in a water-box in the shaft of the Jane Pit at Walker. The box has been filled up until its sectional area is reduced from 7½ square inches to less than half a square inch, and in places it is almost completely closed.

The deposit consists of alternate whitish and brown layers, the white layers being generally much thicker than the brown ones in the upper portions of the box, but the brown layers increasing in thickness further down the shaft. The deposit is moderately soft, much resembling "Bath brick" in texture, and is readily pounded, the colour of the powder being a light buff.

Hydrochloric acid boiled upon the powder dissolved only a very small proportion, and the residue was perfectly white. The acid solution was yellow, and contained iron.

A spectroscopic examination of the residue revealed the presence of barium, strontium, and calcium. With a view of arriving at a rough estimate of the relative proportions of these metals, a portion of the powdered deposit was decomposed by fusion with sodium carbonate, the fusion was extracted with water, the insoluble portion well washed, and dissolved in hydrochloric acid.

The water solution showed a very large amount of sulphuric acid, and a small quantity of silica.

The acid solution gave a small amount of ferric oxide and alumina, a large quantity of barium, a much smaller quantity of strontium, and very little calcium.

The composition of the deposit may then be roughly represented as follows:—

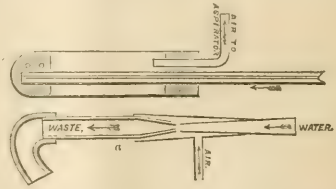
	Per cent.
Barium sulphate, about	90
Strontium sulphate, about	8
Calcium sulphate, about..	1
Silica, alumina, ferric oxide, &c., about	1

The water showed on analysis small quantities of ferric oxide, silica, alumina, and sulphuric acid, a moderately large quantity of calcium carbonate, and a large amount of potassium and sodium chlorides, the total quantity of solid matter being about 800 grains per gallon; but, although about 2 gallons of the water was evaporated, no trace of barium or strontium could be found.

The presence of barium and strontium in the deposit remains, therefore, as yet unexplained, but I have not yet ascertained whether the deposit is still forming, or was forming when the sample of water for analysis was taken.

In connection with this deposit it is interesting to note that about twenty years ago a similar deposit was formed in one of the pits at Walker, which was found by Dr. Richardson to contain about 90 per cent of barium sulphate and 3 per cent of calcium sulphate, the rest being silica, alumina, ferric oxide, and moisture; and I believe that in this deposit also the presence of barium was unaccounted for. This old deposit has since been re-examined for strontium, but gave negative results. I have not yet been able to discover whether the two deposits came from the same pit.

"*Laboratory Notes*," by H. R. Procter, F.C.S. Observing that the Fletcher aspirator is to be exhibited at the ensuing meeting, I venture to describe one which I employ in my own laboratory with very satisfactory results. It is practically that described on p. 163 of the last volume of the Chemical News, by A. Percy Smith, and consists of two tapered jets diametrically opposed to each other. I found, however, that in the original construction it was difficult to secure the necessary rigidity and exact centering of the tubes, and therefore employed some fragments of a common blowpipe soldered together, as annexed, and with a glass waste-pipe cemented into it at *a*. Over the lower end of this is slipped a piece of india-rubber tube for the double purpose of checking the current (which is essential to efficient suction), and of conducting the water and air which are discharged into other apparatus. I am convinced that my arrangement is far less efficient than the principle would permit with better workmanship; but, even as it is, a moderate water pressure rapidly produces a vacuum of 28 or 29 inches of mercury. The uses to which such an exhaustor can be put are very varied. Not to speak of vacuum filtration, I have found it most available for distillations *in vacuo*. Two flasks are connected in the usual way with a Liebig's condenser by tightly fitting india-rubber corks, one of which is pierced by a small tube connected with the aspirator. As soon as the apparatus is exhausted, the connection is closed by a pinch-cock, when a very gentle heat is applied to the flask containing the liquid will cause it to distil rapidly, and without any possibility of loss. The same arrangement may be employed for evaporating to dryness at a low temperature liquids containing changeable organic substances; or the flask containing the liquid may simply be immersed in warm water, and connected directly with the aspirator, when the evaporated liquid will be condensed and washed away with the waste water.



For such uses it is necessary to have some arrangement to render it impossible for water from the pump to recede into the connected apparatus, as it is apt to do if the water pressure varies from any cause, such us turning on an adjacent tap. The best india-rubber valves I was able to construct were apt to leak or fail at the critical moment; but at last I hit on an arrangement, which was not only very simple but gave absolute security. A piece of slender barometer tube, slightly over 30 inches long, was fitted by a tight fitting cork into a test-tube containing a little mercury. The flasks, &c., were connected with the upper end of this tube, while the aspirator tube was passed through the cork into the test-tube. As the exhaustion proceeds the air bubbles through the mercury, but it cannot recede, since to do so it must force the mercury up the narrow tube. The mercury therefore forms an absolutely perfect valve, and may also serve as a pressure gauge, since on turning off the water it immediately rises till it balances the minus pressure of the vacuum.

I have lately made a laboratory barometer, which is both simple and accurate. A millimetre scale is etched on the tube by Bunsen's well-known method, and by the same means a zero mark is made near the bottom. The reservoir consists of a test-tube fitted on with a notched, or rather a split, cork, and the whole is hung to a hook by a little loop of copper wire at the top. A small loop of sheet copper should also pass round the test-tube below to prevent any risk of its sliding too low on the tube and

admitting air. The mercury is of course brought to zero before an observation by sliding the test-tube. In filling it with mercury, the mercury is boiled in the tube as usual, and then a small piece of india-rubber cemented on the bottom of the test-tube is firmly pressed on the end of the barometer tube, the whole turned upside down, and a little more mercury added.

"*Note on Esparto Slag*," by A. J. M. Edger and B. S. Proctor. Some time ago, when a great fire occurred at Boldon, resulting in the burning of a large store of Esparto grass, our friend, Mr. W. S. Scott, had the curiosity to collect a few pieces of the semi-fused ash of the grass, as free as possible from any contamination, and submit a portion to the heat of one of his pottery kilns. The result was the production of a very good sample of bottle glass. Thinking that the subject might be of some interest to our members, we sought and readily obtained from him specimens of the slag and the glass resulting from its fusion, which are now presented to the meeting.

Mr. Scott also informs us that when a corn stack happened to be burnt down in his neighbourhood some years ago, he made a similar experiment, the resulting glass being rather more darkly coloured. Of this he has unfortunately not preserved a specimen.

The Esparto slag, by analysis, yields the following:—

	Per cent.
Silica	64·60
Peroxide iron	3·27
Protoxide iron	0·25
Protoxide manganese	0·75
Lime	10·50
Magnesia	6·25
Potassa	0·82
Soda	9·88
Phosphoric acid	3·38
	99·70

This, when put in comparison with the English grasses, stands far above them in richness in silica; the average percentage of silica being about 35 per cent, with 42 per cent of basic materials, but the proportions varying much with species and with circumstances, the silica ranging from 16 per cent to 63 per cent in the grasses, and from 20 per cent to 80 per cent in the cereal straws, the average percentage in the latter being about 60 per cent.

Comparing the slag with the following tables of the composition of bottle glass, there is a strong analogy between the better quality of bottle glass and the slag, with the exception of an excess of iron in the Esparto slag, and a notable absence of alumina.

	Black Bottle Glass varies from	Average.	Medical Bottle Glass varies from	Average.
Alkalies	3·0 to 6·0	4·5	10·4 to 11·0	10·70
Lime	18·0 to 29·0	23·5	10·0 to 16·0	13·00
Magnesia	7·0	3·5	0·6 to 2·2	1·40
Protoxide of manganese	1·2	0·6	0·5 to 1·2	0·76
Peroxide iron	4·0 to 6·0	5·0	0·7 to 2·5	1·60
Alumina	6·0 to 14·0	10·0	2·4 to 4·5	3·50
Silica	45·0 to 60·0	52·5	62·0 to 71·6	66·30
				97·26

To make the comparison more striking we may group the materials together according to their analogies, and compare the slag with average medical bottle glass as follows:—

	Esparto Slag.	Average Medical Bottle Glass.
Alkalies	10·70	10·7
Alkaline earths	16·75	14·4
Oxide of iron, manganese, and alumina	4·27	5·8
Silica	64·60	66·3

This comparison, equally with the specimen on the table, shows how readily a fire of such materials might, under favourable circumstances, lead to the discovery of glass.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

March 26th, 1877.

Prof. A. Baeyer, Vice-President, in the Chair.

Prof. A. W. Hofmann stated, in connection with the late communications "*On Mono-methyl Aniline*" (Chemical News, vol. xxxv., p. 104), that he had obtained this compound by the action of methylic chloride, bromide, and iodide upon aniline, the latter in excess. Dimethyl aniline, regarded by Kern as the sole product, is produced in equal proportions with mono-methyl aniline, when CH_3Cl is used, and in the proportion of 3 : 1 when CH_3I is used, —CH_3Br giving intermediary results. Mono-methyl aniline is obtained quite pure in the form of the acetyl compound by simple distillation of the products of the reaction with acetic anhydride. Commercial dimethyl aniline is found to contain in all cases variable amounts of mono-methyl aniline.

Prof. A. Baeyer communicated the latest results of his investigations "*On Phenol-Phthalein*." By treatment with HKO it is decomposed into benzoic acid and dioxybenzophenon, $CO(C_6H_4OH)_2$, a body obtained in fine colourless crystals.

Prof. A. Baeyer also gave at length various theoretical considerations inclining him to bestow upon "*Furfurol*," $C_5H_4O_2$, a constitutional formula in which four carbon atoms are joined together in a ring, as in the case of benzene.

Prof. O. Wallach described "*Chlorine Derivatives of Aceto-phenon*." By the action of chlorine alone, besides $C_6H_5COCH_2Cl$, he has obtained $C_6H_5CO_2Cl$. With PCl_5 aceto-phenon forms $C_6H_5CClCHCl$, which easily takes up two additional atoms of Cl and forms $C_6H_5CCl_2CHCl_2$.

By the "*Reduction of Chloralide*" he has obtained dichlor-acrylic acid, CCl_2CHCO_2H. This compound does not unite with two additional halogen atoms as would be expected, the presence of chlorine seeming to affect the additive properties of acrylic acid.

Prof. A. Oppenheim and R. Hellon described "*Ethyl-propionyl Propionate*," $C_2H_5CO.C_2H_4COOC_2H_5$, the next higher homologue of ethyl-acetyl acetate, obtained among a variety of condensation products resulting from the action of sodium upon ethyl propionate. It is a mobile liquid, with characteristic odour and taste, boiling at 200°, and dissolving sodium with ease. The authors were unable to separate out analogous compounds from the liquid products resulting from the action of sodium on ethyl butyrate and isobutyrate.

Prof. A. Oppenheim and T. H. Norton gave an account of a new acid, "*Thiorufinic Acid*," $C_{16}H_{14}S_3O_4$, obtained by the action of CS_2 on the mixture of sodium ethylate; and sodium ethyl-acetyl acetate, resulting from the solution of sodium in ethyl acetate, and apparently a condensation product of xanthic acid, and the analogous derivative of ethyl-acetyl acetate. The acid and its salts crystallise in brilliant crimson needles. The salts of the heavy metals are exceedingly insoluble. Treatment with N_2OH yields alcohol, and a new acid likewise of a bright crimson colour, and exceedingly soluble in water.

The same described also "*Carbo-thio-ethyl-acetyl Acetate*," $CH_3CO.C(CS)COOC_2H_5$, obtained by the action of PbO and CS_2 upon ethyl-acetyl acetate. It crystallises in yellow needles, and is sparingly soluble in ordinary solvents.

The following communications have been received from non-resident members:—

F. Wöhler, "*On the Separation of Arsenic from Nickel and Cobalt*." In order to avoid the precipitation with H_2S, the author dissolves the minerals to be analysed, in aqua regia, and adds Na_2CO_3. The precipitate is treated with oxalic acid, and the insoluble oxalates of the two metals thus obtained are easily and completely separated from the soluble arsenate.

E. Schunck and H. Roemer, "*On Purpurin.*" The authors find that purpurin by heating to 300° is changed into chrysazin. Purpurin is also distinguished from analogous compounds by uniting with but a single molecule of bromine.

P. Friedlander, "*On Diphenylen-Glycollic Acid.*" This acid, $(C_6H_4)C.(OH).(COOH)$, is obtained by the action of HNaO on phenanthrenquinon. By oxidation it yields diphenylen-keton, $(C_6H_4)_2CO$; by heating with water, at 160°, benzhydrol, $(C_6H_4)_2CH.OH$; and by reduction, diphenylen-acetic acid, $(C_6H_4)_2CH.COOH$, which changes easily into fluoren.

H. Hübner and K. Buchka, "*On Phenoxylic Acid.*" By the action of HCl on benzoyl cyanide, at 140°, the authors obtain a yellow crystalline compound,—

$$(C_6H_5COCN)_2H_2O,$$

which yields, with alkalies or acids, phenoxylic acid,—

$$C_6H_5COCOOH.$$

It crystallises in colourless needles, melts at 111°, is very soluble in water, and forms crystalline salts.

L. Claisen describes an acid of the same composition, resulting from the action of HCl on C_6H_5COCN at an ordinary temperature, melting, however, at 66°.

F. Fittica, "*On Nitro-benzoic Acids.*" Additional particulars are given with regard to the fourth isomeric nitro-benzoic acid announced by the author in 1875. He has now succeeded in obtaining it by the action of ethylic nitrate on an ethereal solution of benzoic acid, in the presence of concentrated sulphuric acid. The acid melts at 127°, and is soluble in 380 parts of water. The free acid cannot be changed into its isomers by repeated crystallisations or heating beyond the melting-point. This change is, however, possible in the salts. The barium salt, after repeated crystallisations, yields with HCl meta-nitro-benzoic acid; melting-point, 142°. The ether was obtained by the slow action of ethylic iodide on the silver-salt at a low temperature. It forms yellow needles, and melts at 37°. The fourth isomeric amido-benzoic acid, obtained by reduction from the nitro-acid, melts at 156°, and in the form of the ammonium-salt can be changed into metamido-benzoic acid by prolonged heating. Another nitro-benzoic acid, melting at 135°, prepared by the action of HNO_3 and H_2SO_4 on benzoic acid at a low temperature, is regarded as a physical isomer of the acid melting at 127°, because it possesses the same solubility and yields the same ether and amido-benzoic acid. The author has further obtained two nitro-benzoic acids possessing the same melting-points as meta-nitro-benzoic acid, 142°, and the fourth nitro-benzoic acid, 127°, but characterised by a greater solubility in water and by the bright lemon-colour of not only the acids, but also the salts and ethers.

"*On Benzoic-nitro-benzoic Acid.*" This acid is prepared in the form of the ether, by the slow addition of an ethereal solution of benzoic acid to concentrate H_2SO_4. Saponification with potash yields the free acid. The author gives it the formula—

$$C_6H_5COOH.C_6H_4.NO_2.COOH,$$

and regards it as a molecular compound, although the ether can be distilled without decomposition. A similar acid was obtained from benzoyl-chloride and ethyl-nitrate. The author has successively applied the above-mentioned reactions for the preparation of nitro-acids to other aromatic acids.

M. Fileti and R. Schiff, "*On the Constitution of Cyanamide.*" By the action of chloral on cyanamide the compound $NC.NH_2C_2Cl_3OH$ was obtained, and by treating $CN.NAg_2$ with C_2H_5I diethylcyanamide, $CN.N(C_2H_5)_2$, was prepared, from both of which reactions the authors regard the formula of $NC.NH_2$ for cyanamide as much more probable than NH.C.NH.

E. von Sommaruga and E. Reichardt state, in a preliminary communication on the "*Action of Ammonia on Isatin,*" that they have obtained two crystalline bodies differing from those mentioned by Laurent in his investigations on the subject.

A. C. Christomanos, "*On Iodine-Trichloride.*" The best method for the preparation of this compound, free from iodine, is found to be that of mingling gaseous HI and Cl:—$HI + 2Cl_2 = HCl + IC_3$. The bright yellow trichloride thus obtained melts at 33°, and changes into a yellow gas at 47·5°. Chlorine gas is the only medium in which it can be preserved indefinitely. In air, oxygen, and especially hydrogen, it is extremely volatile. Phosphorus and potassium burn brilliantly if in contact with the solid substance. CS_2 is decomposed with a violent reaction. It acts as a strong oxidising agent with ferrous and sulphurous solutions.

L. Wenghoffer, "*Action of Sulphuryl-Chloride and Ethyl-Sulphuric Chloride on Aniline.*" The author does not find the reactions of $SO_2Cl.OC_2H_5$ entirely analogous to those of $COCl.OC_2H_5$. With aniline sulphanilic acid is produced:—

$$C_6H_5NH_2 + SO_2Cl.OC_2H_5 = C_6H_4(NH_2)(SO_3H) + C_2H_5Cl.$$

Acetanilide yields a more complicated body:—

$$2C_6H_4.NH.C_2H_3O + SO_2Cl.OC_2H_5 = C_2H_5Cl + H_2O + SO_2(NHC_6H_5C_2H_3O)_2.$$

By the action of sulphuryl chloride on acetanilide, and subsequent elimination of the acetyl group, a body was obtained with the formula $C_6H_4.NH.SO_2$.

E. Blankenhorn finds, in the course of experiments "*On the Action of Sulpho-cyanic Acid in statu nascendi on Alcohol,*" that a sulpho-allophanic ether is produced—

$$NH_2.CS.NH.CS.OC_2H_5.$$

By heating with NH_3 at 100° it is changed into sulpho-carbamide.

C. Hell and A. Waldbauer have obtained from the "*Action of Alcoholic Potash on Mono-brom-iso-butyric Acid,*" ethyl-oxy-iso-butyric acid,—

$$(CH_3)_2C(OC_2H_5).COOH,$$

a colourless liquid, with ethereal odour, boiling at 180°, and slightly heavier than water. The salts are very soluble and crystallise finely.

C. Hell and E. Medinger, "*On the Oxidation of the Acid $C_{11}H_{20}O_2$ in Crude Petroleum.*" Both by treatment with HNO_3 and potassium bichromate it is oxidised into acetic acid, and a new acid, $C_9H_{16}O_2$, a nonylonic acid. The authors are of the opinion that the original acid contains no carboxyl group, on account of the decomposition.

A. Naumann, "*On the Decomposition of Molten Potash Alum in Sealed Tubes at 100°.*" After melting, a gradual decomposition takes place, which consists of a separation of water of crystallisation, and precipitation of the anhydrous compound. The free water causes then, in the liquid portion, the separation of a basic compound of alumina, potash, sulphuric acid, and water.

K. Zulkowsky, "*On the Composition of Corallin.*" The author's experiments lead to the conclusions that the commercial dye-stuff known as corallin consists chiefly of the lustrous crystalline substance, rosolic acid, and a dull red resinous body, temporarily termed pseudo-rosolic acid, and yielding by oxidation a dark red compound. A body recently obtained by Liebermann and Schwarzer from phenol and salicylic aldehyd appears to be identical with the pseudo-rosolic acid.

R. Nietzki, "*Decompositions of some Aniline Derivatives by passing through Heated Tubes.*" On passing dimethyl aniline through a glass tube, heated to a dull red-heat, large quantities of benzo-nitrile were formed. Acetanilide yielded, at a bright red-heat, diphenyl-carbamide.

L. Pfaundler, "*On the Temperature of the Vapours issuing from Boiling Solutions of Salts.*" The author seeks to explain the fact that a thermometer surrounded by these vapours always marks a lower temperature than that at which the solution boils, by the hypothesis that

the vapours consist of molecules of various temperatures, —some above and some below the temperature marked by the thermometer, and even of particles of water. When these come in contact with the surface of the thermometer the colder particles adhere, and as they are caused to evaporate by the collision with the more highly heated molecules, the passage into the gaseous state naturally causes a constant lowering of temperature about the bulb of the thermometer.

L. Loewenherz, in a communication "*On Fundamental Thermometric Experiments*," states that a noticeable error in the height of the thermometer is to be observed when it is immersed in mercury, due to the external pressure on the bulb. A change, amounting in one instance to 0·3°, in the melting-point of ice, was also observed to ensue after thermometers had been kept for several days in boiling water.

NOTICES OF BOOKS.

Report upon Geographical and Geological Explorations and Surveys West of the One Hundredth Meridian. In charge of Lieut. G. M. Wheeler. Part VI., Vol. iii. —Geology. Washington: Government Printing-Office.

This Part contains investigations upon mineralogical and agricultural conditions observed in parts of New Mexico, Colorado, and Arizona. We notice an analysis of the mud of the Rio Grande, which, from the fertilising power of its inundations, has not inaptly been compared to the Nile. On the western slopes of Mount Graham a higher night temperature was observed at Camp Grant than at Eureka Springs, 500 feet lower. The author finds that certain plants growing along the slopes of a mountain chain will not thrive in the adjoining valleys—a marked example being the giant cactus (*Cereus giganteus*).

Ozonometric observations were carefully made, with the result that there is no difference in the amount of ozone between healthy and unhealthy localities. Such a statement might have been received with incredulity a few years ago, but the exaggerated views once entertained concerning the sanitary value of ozone have been latterly very much modified.

The whole report may be pronounced full of interesting facts, meteorological, geological, mineralogical, botanical, and agricultural.

Second Annual Report of the Commissioner of the Imperial Mint, Osaka, Japan, for the year ending June 30, 1876. Hiogo: Hiogo News Office.

This report gives interesting proof of Japanese progress in the industrial arts. Mr. Ohno, Superintendent of the Coppersmith Department, has made some forty balances, which compare very favourably with those made by Europeans. Sulphuric, nitric, and muriatic acids are now regularly made, not merely for the use of the mint, but for sale, and about 350,000 lbs. of the first-mentioned have been exported to China. With the exception of Mr. E. Dillon, the assayer, and Mr. W. Gowland, F.C.S., the chemist and metallurgist (to whose courtesy we are indebted for this report, all the high officials of the mint are now Japanese.

The Origin of the Sun's Heat and the Chemical Constitution of the Matter of His System. By W. Couttie. Troy, N.Y.: Scribner.

The author of this pamphlet declares that "the teachings of chemistry are as local as our politics and as changeable as the weather." He asserts that he has discovered an element whose atomic weight is 5, and which, by combining with nitrogen, forms fluorine, chlorine, bromine, and iodine. With carbon it combines to form oxygen and silicon; and with hydrogen to form sulphur and lithium. Its combinations, direct and indirect, with hydrogen, carbon, and nitrogen form all the other elements except phosphorus.

Mr. Couttie makes grievous complaints of the prejudies of scientific men and their opposition to any new truth, if of eminent value. So far as we are enabled to judge no discovery would be so eagerly welcomed as one which should lessen the number of our present so-called elements by proving them to be compounds of a few simpler principles. But we cannot find in this pamphlet any evidence for the author's assertions. If an unknown element by combining directly with nitrogen forms iodine, let him tell us how we may decompose iodine and arrive at the experimental verification of his views. Or let him show us how to decompose oxygen into this same new element and carbon. Till this is done chemists must be excused if they decline to attend to Mr. Couttie's speculations.

CORRESPONDENCE.

BLOWPIPE REACTIONS.

To the Editor of the Chemical News.

Sir,—I was very glad to see in the Chemical News (vol. xxxv., p. 127) the reprint of Dr. Foster's paper, defending Turner's flux against the remarks made upon it by Prof. Chapman in his papers in this journal. Having worked a great deal for some years with the blowpipe, and having very often employed Turner's flux, I was immensely surprised to read what Prof. Chapman said about the test being "altogether superfluous" for boric acid. The statement that it fails to detect boric acid in borate of soda, and that in those cases where it *does* show the colouration the minerals *alone* show it equally well, was quite contrary to my own experience, and I could only wonder how anybody could arrive at results so very much opposed to those of, I believe, all other workers at the subject. My confidence in the very great value of the flux was not at all shaken, but I did not really know its full delicacy till I saw the account of Dr. Foster's experiments, showing its reliability even in presence of such very large amounts of its worst enemy, sodium. I have repeated these experiments with the most satisfactory results; indeed, I think that Dr. Foster might safely have expressed himself even more strongly than he did as to the distinctness of the colourations obtained with the mixtures of salt and borax. I also found that several specimens of tourmaline gave a *very vivid* colouration with the flux, even when the powder of the mineral was ground up with an equal bulk of common salt, though I could detect no green colour whatever when the powder alone was tested, either made to a paste with water or with strong sulphuric acid.

I should like to know whether Prof. Chapman holds an equally low opinion of the value of Turner's flux in testing for lithium. In his paper he only spoke of it in its application to boric acid, and Dr. Foster limits his reply to the same point, though probably he has ascertained its great value for lithium also. Its delicacy for this purpose quite equals, I think, that which it possesses for boric acid. I have made a few trials of it, by grinding powder of *petalite* with increasing quantities of other substances free from lithium, and testing the mixtures with the flux in the Bunsen flame and before the blowpipe. When using, for instance, powdered fireclay, which gave a moderately strong sodium flame by itself, I found that a mixture of 98 parts of this with 2 parts of petalite gave with Turner's flux a most decided lithium colouration in the extreme edge of the Bunsen flame, and a very distinct, though not equally intense, indication in the flame of the blowpipe-lamp. With 99 parts of clay and 1 part of petalite the colouration in the Bunsen flame was still unmistakable,

with care, and still just visible in the blowpipe-flame. Unfortunately, the lithium test does not, like that for boric acid, withstand the presence of very much sodium, and the use of coloured glasses often becomes necessary.

In the new edition of "Plattner" Prof. Richter mentions the flux advised by Poole for detecting boric acid and lithium. It was not given in the former edition, but I have often used it, as Prof. Richter mentioned it to me and others in his instruction in blowpiping. I find it very good in testing for lithium, though not so good as Turner's, but I have always failed to find it of any value in testing for boric acid.

I have made several careful trials of the process recommended by Major Ross for detecting boric acid ("Pyrology," pages 191 and 192), but have not been successful, possibly through some fault of my own, though I think I have proceeded exactly as he advises. I find that when *Zoisite* (or any other suitable earthy mineral) is ground to a paste with a drop of solution of cupric sulphate, this paste, heated on platinum wire, gives a strong copper-green to the flame, which cannot be got rid of even by long blowing. Placed in the Bunsen flame, such paste colours it very distinctly after many minutes, and though the colour decreases in intensity after some time, still the same paste removed from the Bunsen, and again treated at the tip of a strong blowpipe-flame, gives a vivid green, although not quite as vivid as does the fresh paste. When this mass on the wire is removed, crushed again with water and a little tourmaline (as I understand the instructions), and again heated, the green colouration certainly becomes again very strong, as at first. But the same result was always obtained when the mass was re-crushed with water only, and no tourmaline added; just as substances which fuse or sinter in the forceps, and colour the flame less strongly after such fusion or sintering, will often give a stronger colouration again when powdered, made to a paste, and re-heated.

I must own that I did not *expect* to succeed, and was to this extent prejudiced; as all my experience of minerals containing copper oxide, or of minerals made into paste with copper solution in order to test for chlorine, has been to the effect that the green colouration is practically permanent. And even if I found that the addition to such paste of a mineral containing boric acid caused an increase in the intensity of the colouration, I should not feel nearly as safe in relying upon this increase of a colour already present as in relying upon the appearance, even for a few instants, of the sudden and intense change in the flame when Turner's flux is used.

I should be glad to know whether anybody else has tried this process and been more successful than I have been.—I am, &c.,

W. M. Hutchings.

Laboratory, Wallasey Ore Works,
Birkenhead, March 31, 1877.

MOSS COPPER, &c.

To the Editor of the Chemical News.

Sir,—The perusal of Prof. Liversidge's paper (Chem. News, vol. xxxv., p. 69), "On the Formation of Moss Gold and Silver" was a delicious treat to me, in common, I dare say, with many others. Sometimes, when I have ventured to hint at "gold growth," I have been politely referred, along with the "absurd idea," to the company of "Horse-Marines," as being, I suppose, fellows credulous to the *nth*. For several years I have been intently watching certain goings-on in my cabinets, because some of them appeared to be exceptional "*metal growths*," or, as others may prefer to put it, changes, protrusions, elongations, foliations, curlings, scrollings, movements, &c. At all hazards, for the present, I shall call them "growths." I do so because bones, in a sense, are said to grow. Why therefore, in a sense also, may not some stones in certain conditions? Most growth, I fancy, is aggregation. A year or more ago I promised to send you a description of some of these changes, more particularly as regards native gold. Since then, however, they have been so many and so frequent that I have reluctantly put off from time to time writing you thereon, because I had not enough leisure for the *condensation* of what had grown into a rather long story.

My neighbour Mr. Hutchings, I rejoice to see, has given several extremely interesting facts touching the formation of "moss copper." I shall now only allude to some moss copper got at Penzance a few years ago, and which was said to have "grown" in one night, "after a thirteenth fusion," and swept off ingots next morning—a very common occurrence, I was told at the time.

This "moss copper" (a specimen herewith) consists of filaments of various lengths and thicknesses, all more or less gracefully curled or twisted. The prevailing colours now are—Grey, yellow, red, violet, green, scarlet, and purple, in many shades; all brilliant, and some of them beautifully so. Nine or ten months ago, for convenience, I pressed down some of this copper moss into a small paper tray. It has since risen above the edges of the tray (mechanically, perhaps, for the most part), and in some places, with thread-like protrusions, an inch or more long. A few weeks since I took a pinch of it having what I fancied this singular propensity in rather noticeable degree, and put it into a little glass-topped paper box, keeping it within arm's length on my writing-table. One filament has now reached the under surface of the glass top, in an inch and a half "growth." It has got bent at almost a right angle, but has still its termination quite up to the top. Another growth, seven-tenths of an inch long, apparently prefers a nearly horizontal mode of proceeding. I offer no explanation of these metal movements. Most certainly artificial heat had nothing whatever to do with their origin. I mention the facts now, so that some of your readers who are mineral collectors may overhaul their cabinets, and particularly look out specimens of quartz showing native copper or gold. If they have not already observed it, they will probably find argentite and several allied minerals very elegantly sportive. The same will apply to arsenical pyrites which holds visible gold containing 15 to 20 per cent of silver!

I beg to state that I am not writing at all at random, as to this "novel freak of Nature," for I have within a yard of me, at this minute, a hundred or more specimens, of my own finding originally, which are undoubted proofs of sundry kinds of recent metal-growth. Possibly observed facts like these may, in part, be taken to explain how it is that what are called the "tailings" of some gold-mines, after a lapse of time, are found to contain actually more gold, on assay, than when previously assayed! More might be said on this head, and perhaps will be.

Some time in June last, when at Aberdeen, I drew the attention of Prof. Nicol to two gold specimens in the University Museum, which had propensities like specimens of my own which I had previously shown him. There were evidently recent *changes* in the *gold* of these two stones which nobody till then had observed. This opportune discovery, to my delight, half persuaded the esteemed Professor, I think, into favouring the "growth idea." A few days later I had the pleasure of a long talk about this and other things with Thomas Edward, in the funny little Museum at Banff. He has recently been entitled "*Observer*;" allow me to say here, by the way, that I found him *a very 'cute observer* then.

In conclusion, I may say that my present object is not to raise a tempest in a tea-pot about any name that anybody may call anything, anywhere. I merely put the mineralogical facts, and state my belief that the cabinet changes noticed above, and others analogous, are not such rarities as they are generally supposed. This opinion, doubtless, some of your readers already hold, and will presently be good enough to support by further examples. When I have more leisure I will give, briefly, a description of certain gold, silver, and other copper changes

(*growths*) which have come under my own observation.—I am, &c.,

T. A. Readwin.

Tulbrook, Liverpool,
March 29, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 11, March 12, 1877.

Influence of Pressure upon Chemical Phenomena.—M. Berthelot.—The development of hydrogen from the action of dilute acids upon zinc is not arrested by pressure, but merely slackened. The chemical affinity is not modified.

Metallic Iron found at Santa Catarina, in Brazil.—M. A. Damour.—The metal in question has the following composition:—

Iron	63·69
Nickel	33·97
Cobalt	1·48
Sulphur	0·16
Phosphorus	0·05
Carbon	0·20
Silicon	0·01
	99·56

The metal is therefore exceptionally rich in nickel, and presents certain characters, both chemical and mineralogical, which have not hitherto been met with in any meteoric iron of authentic origin.

Measurement of the Thermic Intensity of the Solar Radiations received on the Surface of the Soil.—M. A. Crova.—The calories received normally varied from 0 to 1·21 in fifteen hours of exposure to the sun. The heat normally received on January 4 is 0·61 of that received July 11, but on the surface of the ground it is merely 0·281.

Metals Accompanying Iron.—M. A. Terreil.—Reserved for insertion in full.

Chemical Examination of Mistletoe (*Viscum album*).—MM. H. Grandeau and A. Bouton.—Already noticed.

Acute Poisoning by Acetate of Copper.—MM. V. Feltz and E. Ritter.—The authors conclude that the acetate of copper is a more active poison than the sulphate, but that if mixed with foods or drinks in poisonous doses it imparts to them such a flavour that no one could possibly swallow them without being aware of the presence of the poison.

No. 12, March 19, 1877.

Decomposition of Binoxide of Barium in a Vacuum at the Temperature of Dark Redness.—M. Boussingault.—The author filled a tube of Bohemian glass with fragments of peroxide of barium: a vacuum is made with the mercurial Sprengel pump, and the tube is heated to dark redness. On continuing the action of the pump about 2 litres of oxygen were obtained; the volume which the binoxide used ought to appear. Some binoxide of barium was then placed in a tube, and the temperature was kept at dull redness for about two hours. There merely appeared a few bubbles of gas, due to the expansion of the gas remaining in the apparatus. On causing the mercurial pump to act oxygen was disengaged, on measuring which it appeared that the whole of the binoxide was decomposed. In another experiment the tube containing the binoxide was raised to a slight cherry red there was no escape of gas. A vacuum was made, and immediately oxygen was evolved more rapidly than at dull redness. A tube containing binoxide was heated to dull redness; on making the vacuum a current of oxygen was produced. The heat was then slackened, and in consequence of the cooling the oxygen which had escaped was promptly re-absorbed by the baryta, binoxide of barium being formed again. A vacuum was reproduced in the tube in consequence of this absorption. By thus varying the temperature of the tube the liberation or absorption of the oxygen may be alternately effected. Always after the dissociation effected between a dull and a cherry redness the baryta recovers all its properties, among others that of energetically absorbing oxygen.

Phosphorescence of Organic Bodies.—Dr. T. L. Phipson.—With refesence to a paper communicated by M. Radziszewski (*Comptes Rendus*, February 12, 1877) Dr. Phipson calls attention to his memoir on "Noctiluciné, the Phosphorescent Principle of Luminous Animals," published in the Chemical News for 1875.

Singular Case of the Production of Heat.—M. J. Olivier.—A square rod of steel, 80 centimetres in length and 15 millimetres square, is grasped firmly by both the hands of the operator, one of the hands being placed in the middle of the rod, and the other at one end. The free extremity is strongly pressed against an emery wheel revolving very rapidly. After a few minutes the extremity thus rubbed becomes strongly heated: the hand placed in the middle of the bar does not experience any feeling of heat, but the one at the other extremity is heated to such an extent that the operator is compelled to let go.

Reform of Certain Analytical Processes used in the Laboratories of Agricultural and Meteorological Stations (Part I., Ammoniametry).—M. A. Houzeau.—Reserved for insertion in full.

Preparation of Crystalline Acetate of Magnesia, and on the Fermentation of this Salt.—M. L. Patrouillard.—The author has succeeded in obtaining magnesic acetate in crystals deliquescent in a moist air, but efflorescent in dry air. If the solution is placed in a wide vessel, and exposed to the air for some time, a kind of fermentation is set up, the products being carbonate and formiate of magnesia and wood-spirit.

Simple Method of Producing certain Bi- and Trichlorated Acids.—M. E. Demarcay.—The author makes use of the action of perchloride of phosphorus.

Transformation of Pyro-tartaric Acid into Dibromo-pyro-tartaric and Dibromo-succinic Acids.—MM. E. Reboul and E. Bourgoin.—Not adapted for abstraction.

Action of Chloro-chromic Acid upon Anthracen.—M. A. Haller.—Wishing to utilise the action of chloro-chromic acid, at once oxidising and chlorinising, the author caused it to act upon anthracen so as to obtain bichlorated anthracen, which, on treatment with potassa, should yield alizarin. 10 grms. of anthracen were dissolved in glacial acetic acid, and treated with 30 grms. of chloro-chromic acid freed from chlorine by a current of CO_2. The green liquid was poured into distilled water; the yellowish precipitate collected on a filter, washed, dried, and partly sublimed in a retort, and partly dissolved in alcohol. Both the sublimate and the matter obtained on crystallisation had the form of splendid needles, having all the properties of anthraquinon. They dissolved with a reddish yellow colouration in concentrated sulphuric acid. Water precipitates the bulk of the product from the solution. If melted with potassa they gave a violet mass, which on solution in water was partly decolourised, unaltered anthraquinon being precipitated. The potassic solution, acidulated with nitric acid, filtered, and treated with nitrate of silver, did not give a precipitate of chloride of silver. The product, therefore, contained no chlorine, and was pure anthraquinon.

Constitution of Pseudo-purpurin: Sequel of Researches on the Colouring Matters of Madder.—M.

A. Rosenstiehl.—Pseudo-purpurin, the most complicated of the colouring matters of madder, is so unstable as to produce by its partial destruction all the other madder colours except alizarin.

Biedermann's Central-Blatt für Agricultur Chemie, Heft 1, 1877.

Influence of Conifers in Comparison with other Trees upon the Temperature and the Amount of Ozone in the Atmosphere.—L. Fautrat.—Air above woods is cooler in summer and warmer in winter than air taken at the same elevation above the bare ground. Ozone is less abundant, especially over forests of coniferous trees.

Removal of Plant-Food by Rivers.—Prof. Harlacher and Dr. J. Breitenlohner.—An account of the fertilising matter carried away from Bohemia by the waters of the Elbe. The sewage of most of the riparian towns, especially Prague, flows directly into the river.

Contribution to the Knowledge of Arable Soils.—Dr. J. Hanamann and L. Kourimsky.—Proceedings of the chemico-agricultural Station at Lobositz, founded by Prince Schwarzenberg.

The "Peculiar Soil" of Hungary.—E. de Kvassay.—An account of certain soils rich in soda. Few plants flourish on these soils; the wheat is remarkably heavy; the grass, which consists almost exclusively of *Glyceria maritima*, fattens sheep very rapidly; and the plums, pears, and apricots are remarkably sweet. The trees, however, do not live long.

Chemical Analysis of Fossil Bones.—Prof. Krocker.—The bones in question are found at Olkusz, near the frontiers of Poland and Silesia. They contain in some cases as much as 74 per cent of calcic triphosphate, and are remarkably free from iron and alumina.

MISCELLANEOUS.

Appointment of Public Analyst.—Mr. A. H. Allen, F.C.S., &c., has been appointed Public Analyst for the West Riding at a salary of £250 per year, and 6s. for each analysis.

Qualitative Blowpipe Analysis.—The Council of the Society of Arts announce that they are prepared to offer Prizes of £5, £3, and £2 respectively, and Certificates, for Proficiency in Qualitative Blowpipe Analysis. The competition is open to any person, but as it is intended principally for those interested in the mining industries of Devon and Cornwall, the Examination will be held in the centre of the mining districts. The arrangements will be in the hands of a Committee of the Miners' Association, and intending candidates should apply to the Honorary Secretary of the Association, Mr. J. H. Collins, Lemon Street, Truro. The Examination will be held at Redruth, from 5 to 9 p.m., on Tuesday, 5th June, 1877, and will be conducted by Dr. Clement Le Neve Foster, H.M. Inspector of Metalliferous Mines. The Examination will be entirely practical, and the following will be the conditions.—1. No Prize or Certificate shall be given unless the candidate has taken a Certificate in the Science and Art Department Examinations in Inorganic Chemistry and Mineralogy. 2. The candidates will have to determine the composition of several minerals and simple artificial products, writing down each experiment, its result, and the inferences drawn from it. The examiner will have the right, during the practical examination, of putting questions to the candidates to test their ability. 3. Each candidate will have to bring his own blowpipe, lamp or candle, platinum forceps, reagents, platinum wire, charcoal, spirit lamp, glass tubes, &c., and any other blowpipe apparatus he likes. Any dry reagents may be used, but the only wet reagents allowed will be nitrate of cobalt and water. The use of gas and blowing machines will not be permitted. 4. If two or more competitors for prizes are equal, their respective merits will be decided by a second examination. 5. Persons who have not passed the Science and Art Department Examinations may present themselves for examination in Blowpipe Analysis, but they will not receive a Certificate until they satisfy Condition No. 1.

NOTES AND QUERIES.

Valuation of Sulphur Ores.—Can any of your readers tell me how sulphur ores are valued; I do not mean how the sulphur is estimated, but how it is valued when estimated?—Chemicus.

Chemical Schools in France.—Would any of your correspondents kindly give me the names of one or two of the principal "Schools or Colleges of Chemistry" in France?—Chemicus.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

February, 1877.

The following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·000	0·006	0·165	0·073	21·30	7·840	0·360	0·86	1·666	13·2	2·4
West Middlesex	Slightly turbid	0·000	0·007	0·180	0·077	20·70	8·960	0·360	0·86	1·600	12·6	3·8
Southwark and Vauxhall	Slightly turbid	0·001	0·007	0·180	0·077	20·60	8·790	0·360	0·86	1·633	13·2	3·8
Chelsea	Slightly turbid	0·000	0·006	0·180	0·066	21·30	8·680	0·396	0·86	1·700	13·2	3·3
Lambeth	Slightly turbid	0·000	0·008	0·210	0·056	21·60	8·960	0·432	1·01	2·166	13·2	4·2
Other Companies.												
Kent	Slightly turbid	0·000	0·003	0·390	0·001	28·60	11·760	0·504	1·51	4·000	18·8	6·0
New River	Slightly turbid	0·000	0·005	0·135	0·049	21·70	8·680	0·360	0·86	1·500	14·3	4·2
East London	Slightly turbid	0·000	0·007	0·180	0·063	19·80	9·128	0·432	1·01	2·266	15·4	4·2

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

Note.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. Meymott Tidy.

THE CHEMICAL NEWS.

Vol. XXXV. No. 907.

THE NEW "PATENT" BILL.

There have been revolutionists who desired the equal distribution of land, and schemes of fraud and violence have in all nations had great success. There are some Governments who wait until individuals accumulate wealth, and then seize upon it by some pretext, whether directly or by increased imposts, or, as in smaller communities, by increase of rent; but it has been reserved for our age to raise up a class of men to prey upon the thoughts of inventors, and grip them as soon as they emerge from the dark recesses of the brain and are expressed in a form of speech or writing. These men of violence are also men of talent, and in an age of science they seek also to be scientific and hide their propensities in the words of apparently economic law.

The above reflection is one very simple result of considering opinions of late found floating regarding patents. We have been told that there can be no property in thought. We say that thought alone is real property, and it is with pleasure that we see a Government willing to watch over the interests of inventors, so as to induce them to give to the nation that valuable property which, if they please, no power can take from them, but which from its peculiar character cannot be used for their own benefit without the aid of the State, whilst, if once seen, it may be used by strangers and abundantly appropriated by the unscrupulous. It is proposed to extend patent rights from fourteen to twenty-one years. This change is in the right direction. We owe much to inventors: it is difficult to say how much of the superiority of which the nation boasts is due to invention, but it is a very large proportion. There are still many who tell us that our position is owing to our spirit or "pluck," and a clergyman once told us that the pluck was obtained by port wine. This is the way that even some educated men seek out the causes of things. There must be good roots and feeding to produce a fine tree; but a tree is known by its fruits, and our country is great by its invention. We live by the cunning of our right hands—the gift of a Providence which gave us also the crude material. There are some men who would assign as a cause of our position, physical strength and brute power of fighting; but what is a man before the engines of war? Men who attribute all success either to strength or to mere vigour of animal spirits, unreasoning and unsystematic, are like some ancient Celts who, on invading Italy, rushed on the armed Romans without clothes and without weapons. They were true believers in pluck, but it failed; and thus Rome lost some blood that would have made a good mixture. Others think we owe our superiority to land, although we buy food for some months of every year. Such men are like the coins we used not long ago, which asserted, in spite of facts, that the King of England was King of France. It is by invention, in a great measure, that we induce the world to send to us all its choice things. If there is any class of men which we ought to honour it is inventors, and yet we struggle about their rights in little bills that are humiliating in our opinion. A wider mind than usual has touched a key in this new proposal, but little men also have done their part; this appearance may be owing to its being an accumulation of Acts.

The Commissioners of Patents are to be numerous; six are named, and five more are to be named—all, we suppose, lawyers, as the six are: why so many, who can tell? But "the number of examiners shall be *two*, and the number of assistant examiners shall be *two* or more, not exceeding *four*." "They shall be specially qualified for the office by legal or scientific knowledge."

It appears, then, that of the *two* or *four*, or, adding them, six, one at least shall be legal, or may be legal. This would leave of scientific men only one, or five at most, perhaps fewer; it is not said how many are to be lawyers.

When a patent is filed it is first scrutinised by the examiner. There are about five thousand patents applied for annually, and the examiners must read them all. Let them work without rest for three hundred days in the year. The patents are to be examined again when the full specification is given in, after three months, and this must be compared with the provisional. There are, then, ten thousand specifications to examine and to report upon, and each report is to be of value. We have, then, thirty-three patents daily, or six patents to each. For each patent one man at least has toiled long and spent money; for some it is the end of years of toil: but now a stranger must give his opinion on six daily,—a little more than an hour to the whole labour of a patent,—writing also a report upon it that will bear examination in a Court. But we doubt if this is judging fairly. There are to be only *two* examiners, and it is to be supposed that each patent shall pass examination by one of them, and, although assisted, the meaning must pass through his brain. If not, then the assistant examiners become true examiners, and not assistants. With this more correct reasoning an examiner must pass at least sixteen specifications in a day, which, with all the aid of assistants who may have had half an hour longer to examine them, is a task inconceivable. Surely the scientific man is expected to do wonders. We have heard a whole court and many lawyers arguing about a patent for days, whilst the arrangements occupied months. No wonder that the scientific man may now be asked, as in Clause 46, to assist the Judge. It does at least show the advance of scientific influence—an advance made absolutely necessary and long struggled against. But it may be asked, how many examiners should we recommend? We cannot tell. If the system is to be carried out, there must be enough to do the work. Clerks in any number may be appointed, but no assistance will enable the examiners to pass through their brains, in a profitable manner, the number of inventions demanding protection, or we must greatly over-rate invention and under-rate the power of the examiners.

There is another question—What is a scientific man? It would seem as if he were spoken of as a man knowing all science. There must be some one or more with a minute amount of mechanical knowledge. There must be one or more with an equally minute amount of knowledge in chemical manufactures; but there are various departments of mechanics, and so of chemistry, and pure scientific knowledge will by no means be enough. Besides these there are other departments, and some strange outlying districts of knowledge. But perhaps we are wrong. In Clause 51 the Commissioners are given power to appoint as many officers as they think fit, notwithstanding the precise clause regarding examiners and assistant examiners. Perhaps this is one of the modes of evading the prior clauses, but we should much prefer the removal of these apparently contradictory or impracticable clauses.

We have been spending some sympathy on these examiners as being overworked, but in Clause 52 we find that the Commissioners may set them to arrange, index, and abridge the specifications. Is this to be done after their work? This of course shows that the whole has not been considered by any one who has been fully made aware of the difficulty, or else the meaning of the terms is not such as we understand. We write under fear that we do not fully understand the phraseology, and may be doing or thinking unjustly.

In 62 we observe a peculiarly objectionable addition, and apparently without the smallest use. The extended time is not to apply to patents unless taken out after the

passing of this law. What quality can be found in patents after the law that ought to exclude others? We hope that this narrow feeling will be hidden from view.

As to the prices, it has been shown that the country gains so much from patents that it would be well not to ask too much for the so-called privilege. Patents have gained wealth, and must not pay for the permission to make the country rich: they ought only to pay, as it were, a police for their protection. It would be nobler when extending the time not to extend the price. £110 are wanted for renewal, and patent agents will require an addition. It is a large sum to many a poor patentee—a small sum to a few only. We should be glad to see the sum reduced to £50 every five years—not a great reduction, but a uniform charge and abundantly high—the first £50 to be paid in the sixth year.

The amount of fees to be paid for the patent when granted justifies the expectation that the work will not be done in a slovenly manner, and even if not granted the amount to be paid is sufficient.

The full specification is to be filed three months after the provisional, instead of at present six. We see no good reason for restricting the time and privilege of the patentee in this case, and would prefer not to meddle with the time now allowed.

Although the time of application is fixed, the time for giving a report on the patent is left very open, and we are informed in Clause 8 that "The use and publication of the invention after the application and within a period of *twelve* months from the date of the application shall not prejudice the grant of a patent for the invention." This seems to look to a very long delay in reporting; and when we consider the few scientific men employed, and the large number of legal authorities, we have two sufficient reasons. It will certainly be a painful thing for an inventor to wait so long, and still more painful should he be told, after using his invention for a year, that it is not his. We must therefore conclude that the machinery for reporting is insufficient, if we understand it properly.

The question may be asked whether the principle is correct. On this point we have a decided opinion, we believe it to be right to scrutinise patents; but whether there are human beings yet created wise enough to carry it out well enough in England is not known to us, but we certainly think that it is well to try. We can point to conspicuous failures in the plan, and we can point to that which, in the opinion of many, is a success.

The right of the Government to use a patent on its own terms seems arbitrary, but perhaps unavoidable.

The demand that a patentee shall make efforts to have his patent used is severe. Why should an inventor have laid upon him the trouble of treating with others to have his plans adopted? This is a labour for which the inventor is often quite unfitted and eminently unfitted. The only fair demand made upon him in this respect seems to us to be that he should give licenses when required in a reasonable manner, and this is a very important improvement.

We have mentioned some points that are decidedly against the Bill, but these can be amended, and, indeed, must be. Gradually our legislators will learn the importance of patents, and still further advances may be made in future. There has been a difficulty in the minds of some persons as to the rights of inventors as compared with writers. The principle must be the same—the protection of wealth made by the brain. The different quality of the products decides a difference in treatment. If we buy a copyright book we pay the writer through the publisher, or we hope to do so, and an inventor must have a manufacturer or publisher for his invention, keeping or selling the copyright. The difficulty in the case of the discoverer is not one of principle. He deserves a protection for the wealth of his mind, but we have not yet fully discovered the best mode of giving it. When people use his ideas and honour him, he receives part of his reward, sometimes all he desires, and we have an opinion that discovery is so noble that it is scarcely possible to give an equivalent. Who can tell the value of a law of nature, and what shall we pay for it? We give love and honour, and we like to see the discoverer above the evils of poverty; but we have not yet learned to give him his due position, and we shall never be able to fix his due payments. We leave the subject amongst sacred things at present.

Some people imagine that patents are a voluntary boon, a gracious gift to inventors. It is otherwise; inventors endow the nation with their inventions, and are allowed by means of patents that protection which property must have in order to prosper. There are men who argue as to the rights of inventors; but who can decide about the rights of man? Many subtle questions arise in such a discussion. Others, again, say that patents are given, not as a right but as a matter of expediency. The rights of inventors are like those of the Emperor of Russia—right or wrong you cannot remove them; they are like those of the possessors of the soil by legitimate inheritance; but, in addition, inventors have a right exactly akin to that which a man has to his own life, and which it is the bounden duty of a Government to protect. The use of the law is to protect our bodies, and we must add also to protect our minds, our freedom of thought, our right to the wealth of our brains as well as of our hands. Besides this the inventor has a still higher right, that of keeping all to himself and telling no one, and this right we know he exercises when not well dealt with.

Let us be thankful that there are men who invent. We know of places with too much law; we know of none with too much invention. Let us foster that which needs fostering. In principle we are pleased with the Bill because it allows a certain position to science hitherto denied, and certain rights to inventors above those recognised; but we have a little laugh when we look at the modest way in which these great powers are allowed to stand in the face of high society. We may make some curious comparisons, and one that suits the time is the slow progress of relief given to the Jews, until now all nations seek their help, and one stands at the head of our affairs, and has affected lately the destinies of Europe and the world. Science and invention are not smaller, and they will grow.

ON THE NEW METAL—GALLIUM.*

By M. LECOQ DE BOISBAUDRAN.

I. GALLIUM has been too recently discovered for its study to be very advanced at present. By reason of the great scarcity of the new element in the ores at present examined, the time which has elapsed since its discovery has been principally devoted, first, to the search for a practical method of extraction; then to the treatment (always a long process in a small laboratory) of several hundreds of kilogrammes of ore; lastly, to its purification, necessarily very complicated, on account of our ignorance of the way in which gallium behaves itself with many reagents.

I am therefore able to give only a very incomplete history of gallium. This sketch will, nevertheless, I hope, be sufficient to serve as a basis for the researches which other chemists will perhaps undertake.

II. *Historical.*—Since I have been occupied with chemistry my attention has always been directed to the question of the classification of the elements. Interesting relations had already been noticed by several *savants* (particularly by M. Dumas) between the atomic weights of certain simple bodies, and the properties which have led chemists to group those bodies into one natural family. I applied myself to the task of discovering new relations, either by comparison of the atomic weights of the elements, or by that of their qualities: such, for example, as the emission at a high temperature of luminous rays of deter-

* Communicated by the Author.

mined wave-lengths. I thus discovered some relations hitherto unknown, and I drew from them some novel deductions.

The substance of these ideas was deposited with the Secretary of the Institute in sealed packets, and I had the honour of explaining my ideas somewhat more in detail before some illustrious chemists, principally in conversation with MM. Dumas and Friedel.

Amongst the conclusions that might be drawn from my attempts at chemical classification was the probability of the existence of unknown elements coming to fill up the gaps left vacant in the natural series. It is clear that the position thus occupied in a chemical family by a hypothetical body indicates approximately the properties of that body.

However, speculations of this kind are always attended with a certain amount of indecision. Thus, notwithstanding the importance which I could not help attaching to the hypotheses born of my imagination, I did not think it right to publish them without their having been first submitted to experimental proof, and without having made strenuous efforts to obtain from them positive results for their confirmation and further development.

The present perfection of chemical analysis, and the care with which nearly all the known minerals have been examined, leave little hope of finding new elements; we can only expect to meet with them as minute traces disseminated in considerable masses of foreign substances.

The uncertainty which inevitably prevails in the exact chemical reactions of a hypothetical body, defined by its individual position in a natural series, renders a success founded solely on the direct application of those reactions *calculated beforehand* rather problematical, for the slightest error in the conjecture of one of them may drive the body sought for out of the analytical place which theory assigns to it. This difficulty seemed to me very great, and to obviate it I invented a particular method of mineral analysis, so that an error bearing either on the properties of the bodies sought for, or on those of the known elements, would not interfere with the final issue.

By reason of its extreme sensibility, spectrum analysis is a great assistance in this kind of work; but it does not constitute an essential and indispensable part of my method of research. It is, however, a marvellous instrument, whose power must be utilised, and to the successful application of which I formerly devoted several years. I believe that the spectral examination of so small a quantity of liquid as that by which I proved for the first time the existence of gallium would have been impracticable before the considerable modifications to which I submitted the apparatus for obtaining electric spectra. My designs, carried out *under well-determined experimental conditions*, were equally indispensable to guide me amongst the numerous rays which the metallic spectra contains.

My first attempt at research for new elementary bodies was made fifteen years ago. At that time I possessed no laboratory, and the instruments at my disposal were quite inadequate. This attempt, which was made with a considerable amount of material, had to be abandoned before it was finished, and the greater part of the results obtained were lost. In 1863 I built my present laboratory, and furnished it with more complete apparatus. I renewed my attempts, and made several series of researches, but without any success; I evidently employed too small a quantity of material. These experiments were not, however, entirely useless, for they gave me an opportunity of perfecting the method on which I am continuing to work, in the hope of one day publishing it.

At last I decided to operate on a larger scale, as I had done at first, and in February, 1874, I began the treatment of 52 kilogrms. of blende of Pierrefitte, obtained for that purpose in the autumn of 1868.

On the 27th August, 1875, between 3 and 4 o'clock in the afternoon, I perceived the first indications of the existence of a new element, which I called "Gallium" in honour of France (Gallia).

Guided by certain considerations, I anticipated a little, I must confess, on the rigorous course of my methodical analysis. I then treated, preliminarily, on the 27th August, a portion of a white deposit which began to form in one of my products in contact with plates of zinc. This deposit was dissolved in hydrochloric acid, and the solution precipitated by ammonia in excess. It was then filtered, evaporated, and the ammoniacal salts destroyed by boiling with aqua regia. The liquid thus obtained, submitted to the action of the electric spark, showed in the spectroscope, besides many known rays, a very faint trace of a violet ray, situated towards 417 on the scale of wave-lengths.

This ray not existing in any of my drawings of spectra, I had no doubt that I was dealing with a new element, and I immediately proceeded to augment my supply of precious material.

I estimate that the quantity of gallium in the little drop of liquid examined at my first observation did not exceed 1-100th of a milligrm. The whole of the white precipitate which was already formed was immediately dissolved in hydrochloric acid, and treated in the manner previously stated. The resulting acid liquor was saturated with sulphuretted hydrogen, filtered, then submitted again to the action of sulphuretted hydrogen, after having added an excess of acid acetate of ammonia. A sulphide of zinc was separated,* which, dissolved in hydrochloric acid, gave clearly in the spectroscope the ray 417 and another violet ray, more feeble, situated towards 403 on the scale of wave-lengths. Subsequent observations proved that this ray 403 belongs also to gallium.

Thanks to these first experiments, I had then, from the night of the 27th to 28th August, proved beyond doubt the existence of a new body; but I had only obtained a small quantity of it, estimated at one-tenth of a milligrm., and containing many impurities. I, however, made use of it to study, as well as I was able, some fundamental reactions which I described in a sealed packet addressed to the Académie des Sciences on August 29th (opened the 20th September, 1875).

A few days after the hydrochloric solution of the gallium sulphide of zinc was precipitated by carbonate of barytes; the precipitate was then washed, and treated with a mixture of hydrochloric and sulphuric acids. The resulting salt showed, besides the zinc spectrum, the rays 417 and 403 already well marked.

During this preliminary examination of the compounds of gallium my general analysis was being actively carried on. At the end of three weeks I had succeeded in acquiring about 2 or 3 milligrms. of gallium chloride still mixed with chloride of zinc. I then went to Paris, where, in the last week of September, 1875, I had the honour of conducting before the Chemical Section of the Institute a course of experiments demonstrating the individuality of gallium.

I would here remark that if I had not anticipated the results of my method of analysis the discovery of gallium would perhaps have been a few weeks later, but the conditions would have been such that its existence could not have escaped the notice of the merest tyro in spectrum analysis. In fact, except the previous treatment of a part of the white precipitate formed by zinc in one of my products, the execution of the plan *marked out beforehand* was as rigorously pursued as if I had been ignorant of the presence of the new element. I thus succeeded in obtaining with a few drops of the solution the two gallium rays, no longer in scarcely perceptible traces, but extremely bright, far more brilliant indeed than any of the other metallic rays present.

It will be seen, then, that, possessing as I did exact drawings of the spectra furnished by all the known elements, gallium would have been discovered, in the absence of all preconceived ideas, by the simple application of the analytical method that I followed.

It now became necessary to increase the quantity of

* The white precipitate formed by contact with metallic zinc contained sub-salts of zinc.

material for study. Thinking it probable that the Pierrefitte blende was not the most advantageous mineral for the extraction of gallium, I tried a large number of blendes and products of zinc works. I succeeded, however, in finding only two richer than Pierrefitte blende: these were the yellow transparent blende from Asturias and the black blende from Bensberg. All the other substances I examined were much too poor.

Thanks to the kindness of the mining companies of Vieille Montagne, of Nouvelle Montagne, and of Corphalie: of my friend, M. Friedel, and especially of M. Malgor, the engineer of the mines of Pierrefitte for the Asturian Company, I obtained considerable quantities of ores, which were treated, not by my general method of research, but directly for gallium. My acknowledgments are also due to M. Wurtz for the liberality with which he opened his laboratory to me during my stay in Paris, and for the trouble he took in bringing me into communication with several directors of manufactories who have kindly sent me materials which have been most useful in my experiments.

Before beginning to operate on several hundreds of kilogrammes of ores it was necessary to find a quicker and less expensive method of extraction than that employed to isolate the first milligrammes of gallium salts.

During the crushing of the ores and their treatment with over 1500 litres of aqua regia, I continued the examination of the chemical properties of gallium by utilising the few milligrammes of chloride produced from the first sample of Pierrefitte blende; it was with this product that the ammonia-gallic alum and the solid metallic gallium presented to the Académie des Sciences on the 6th of December, 1875, were prepared, and also the *liquid* gallium, described in the sealed packet received by the Academy on the 6th of March, 1876, and opened on the 1st of May.

The relatively large quantities of gallium extracted from the products of my grand operation enabled me to verify the facts formerly observed, and to determine some other properties, such as its density, fusing-point, &c.

Gallium was reduced to the metallic state for the first time in November, 1875, by the electrolysis of an ammoniacal solution of its sulphate. The metal was deposited on a sheet of platinum serving as a negative electrode; the positive electrode was at the same time covered with a whitish film, formed by a pellicle that was easily detached from the platinum, insoluble in a large excess of ammonia, but easily soluble in hydrochloric acid.

In this first experiment 1·6 milligrammes of gallium were deposited in four and a half hours on a platinum foil of about 185 square m.m. surface; the surface of the positive electrode was 877 square m.m. The battery was composed of five bichromate pairs (zincs = 17 × 10 c.m.) connected for tension. In order to avoid any mistake as to the nature of the reduced metal it was dissolved in hydrochloricacid; the solution gave a beautiful electric spectrum of gallium, but also, though very faintly, zinc rays and minute traces of other rays.* The metal obtained then was gallium, but containing a small proportion of zinc.†

A second sample of gallium prepared under the same experimental conditions as the former was laid before the Academy on the 6th of December, 1875; it weighed 3·4 milligrammes, and was deposited in five hours forty minutes upon a surface of about 123 to 124 square m.m.; the positive electrode was furnished by ten bichromate pairs (zincs = 17 × 10 c.m.) connected for tension.

These two specimens of gallium presented all the chemical properties of pure gallium, but the physical aspect was quite different. They were presented in the form of a solid button adhering to the platinum and polishing badly when rubbed with an agate burnisher, but better when strong pressure with the same burnisher is used, the metal being brittle and a little whiter than platinum.

When the electric current was duly regulated together with the relative dimensions of the electrodes gallium assumed a beautiful silvery appearance: at the end of the operation the surface was finely granulated, and scattered over with brilliant points, which the microscope showed to be crystals; there were here and there some points, larger and more brilliant than the others, which had quite the appearance of little craters, the sides of which were covered with crystals.

The time required for the electrolysis of the ammoniacal solution of gallium was very long for the small quantity of metal obtained; I therefore employed caustic potassa, which dissolves a large quantity of oxide of gallium and forms a solution which readily undergoes electrolysis. This experiment I performed in February, 1876, when I only disposed of a few milligrammes of substance which had escaped previous electrolysis. I was astonished to find that the gallium was separated from the caustic potassa solution in the form of a dull greyish white coating, composed of innumerable small *liquid* globules. I immediately divided the metal (there was about a milligramme of it) into several portions to be submitted to separate experimental trials. It was thus demonstrated: 1st. That this liquid gallium possessed the same chemical properties as the solid gallium of the earlier preparations. 2nd. That it did not contain mercury, its hydrochloric solution not being coloured by iodide of potassium, ammonia, or hydrosulphate of ammonia, nor did the metal volatilise at red heat. Spectral examination showed that liquid gallium was purer and contained less zinc than solid gallium produced by ammoniacal solutions.

A very small globule exposed for several weeks on a plate of glass to the open air of the laboratory did not lose its liquidity and preserved its metallic lustre. It was, however, divided every day, then re-united by means of a fine steel point, and the surrounding temperature lowered almost to zero if not rather below it. The liquidity of this gallium can scarcely be attributed to the presence of potassium reduced by the voltaic current, for the alkaline metal would then have been quickly oxidised both during the washings and by contact with moist air.

In the sealed packet received by the Academy on the 6th of March, 1876 (opened on the 1st of May), I expressed my belief in the probable liquidity of pure gallium, attributing the solidity of the first specimens to the large proportions of foreign metals they contained. I also said that we might still suppose that by the electrolysis of the ammoniacal solution there is deposited, not pure gallium, but a compound of that metal with the elements of ammonia (hydride, amidide, nitride). That was not impossible, but seemed scarcely probable. Having, towards the end of April, 1876, prepared 10 centigrms. of gallium, which I had reason to believe was very pure, it became easy for me to explain the singular facts I had noticed in the specimens which had served for my earlier researches.

I have recently re-united and treated all the gallium products in my possession, and I have obtained from them 65 c.c. of pure gallium. A few decigrammes are still disseminated in different residues. I do not think, however, that the whole quantity extractible (including the 65 centigrms.) exceeds or even reaches 1 grm. Such is the yield of about 430 kilogrms.* of raw material, some of which, it is true, was extremely poor. With 430 kilogrms. of Bensberg blende several grammes of purified gallium would evidently be obtained.

(To be continued.)

* The zinc rays were rather more marked in the spectrum from the hydrochloric solution of metallic gallium than in that from the material which had served for that preparation. This may be readily imagined, since ammoniacal solutions of zinc are very easily reduced by the voltaic current. The zinc ought then to accumulate in the first metal deposited, which is precisely what occurs. The oxide of gallium that remained in the solution, or that was precipitated in an insoluble state during the operation, had been in part deprived of zinc by the electrolysis itself.

† The spectral reactions of chloride of iron not being very sensible it is possible that a certain quantity of iron might have been contained in the first specimen of gallium.

* The 120 or 130 kilogrms. of laminated zinc employed as a reagent are not included in the 430 kilogrms. This zinc, indeed, seems to be almost entirely free from gallium.

ANALYSIS OF CHROME IRON AND STEEL.

By WILLIAM GALBRAITH, F.C.S.

HAVING for some time had occasion to make frequent analyses of chrome iron and steel, I found there were a number of difficulties presented themselves, and, as it was a matter of importance to return the analyses in a short space of time, it became necessary to devise some means of quickly determining the percentage of chromium, &c.

The first difficulty I found in analysing the chrome iron, or chromium as it is called, was the fact of its insolubility in the usual reagents used in the analysis of irons. Nitric acid will not dissolve it nor hydrochloric acid, but nitro-hydrochloric acid will dissolve it in time; *i.e.*, if the chromium is as high as 10 per cent it may take four or five days' boiling before it is dissolved. I found, however, that the best solvent was dilute sulphuric acid, in which it dissolves very rapidly; and here I may say that a writer in a late number of the CHEMICAL NEWS describes a process of determining the chromium, in which he pays not the slightest attention to the fact of its insolubility, commencing the description of his process after it is in solution.

The method I have adopted for the determination of the chromium is as follows:—

1 grm. of the chrome iron is dissolved in dilute sulphuric acid (about 6 parts of water to 1 of acid). Sufficient potassium permanganate to oxidise all the iron is now added, and then about as much more, and the solution boiled until the colour of the permanganate is destroyed. If there is a large excess of the permanganate it will of course take some time, which can be hastened by the addition of a little more sulphuric acid. I may say that I use the crystals of potassium permanganate, and that it is necessary to have the excess of permanganate, otherwise some of the chromium may escape oxidation, especially if there is much chromium. The black or dark brown precipitate, consisting probably of a mixture of permanganate and oxide of manganese is now filtered, washed well with hot water, and to the filtrate, which should of course be of a bright yellow colour, is added a known weight of ferrous sulphate, or preferably ammonio-ferrous sulphate, and the excess of iron determined with a standard solution of potassium bichromate.

This method I have found to give very accurate results, and as it does not occupy much time (not more than half an hour) it leaves little to be desired.

Steels of course are done in precisely the same manner, with the exception that 2 or 3 grms. of the sample are taken instead of 1. The following are a few examples of my test experiments:—

	Chrome Iron.		Steel.	
	1st.	2nd.	1st.	2nd.
Chromium ..	6·88	6·79	0·85	0·83 per cent.
			0·46	0·45 ,,

Another test experiment was made by adding 10 c.c. standard potassium bichromate to a sulphuric acid solution of ferrous sulphate, then adding permanganate, and proceeding as above. Thus, 1 grm. ferrous sulphate took 19·3 c.c.; by using 10 c.c., 10·0 c.c.; and proceeding as above 1 grm. took 9·3 c.c.

Carbon.—This I have done in the irons by the sulphate of copper process, and burning the carbon and copper together in oxide of copper, with the aid of a current of oxygen, and, although a little of the chromium is left with the copper, it does not interfere with the accuracy of the process.

I may note rather a curious fact here, that while the iron readily replaces the copper in the case of chrome irons, it refuses to do so in the case of chrome steels, the steel being only coated with copper, and remaining so for weeks. I have also made some estimations of carbon in the irons by combustion with lead chromate and potassium chlorate, which agree very closely with those made as above; but it is evident this is not a useful process for steels, as it is not easy to [illegible] steel into fine enough powder. Probably Weyl's galvanic process gives the best results.

Silica, Sulphur, Phosphorus, &c.—These can all be determined as usual in the steel, and with regard to their determination in chrome irons I hope to be able to make it the subject of a future communication.

Sheffield, April 4, 1877.

SCOTTISH TRIPOLITE.

By W. M. PATERSON.

IN the autumn of last year I received a sample of what was supposed, by the friend who gave it me, to be a sample of clay. I happened by chance to examine it under the microscope recently, and was surprised to find that it consisted almost entirely of fossil or sub-fossil diatomaceæ. The sample received is of a greyish white colour, and remarkable on account of its extreme lightness.

On being calcined the colour, evidently due to a trace of organic matter, disappears, leaving behind a powder of the purest white. A portion of the calcined on being submitted to analysis gave the following result:—

Silica	95·66
Alumina	3·08
Oxide of iron	trace
Lime	0·28
Further loss on ignition ..	1·25
	100·27

The sample contained little sand, and readily dissolved to the extent of 92·4 per cent in solution of potassium hydrate.

From the above analysis it will be seen that this deposit varies considerably from the celebrated Barbadoes tripolite, or that from Sweden, the former containing 10 per cent of calcium carbonate, and the latter 6 per cent (analysed by Dr. Phipson, *vide* CHEMICAL NEWS, vol. xxxiv., p. 108).

Its composition agrees very closely, however, with that from the Puy de Dôme, France, which was found by Fournier to contain:—

Silica	87·2
Alumina and oxide of iron ..	2·8
Water	10·0
	100·0

If the above were calcined it would be composed as follows, agreeing pretty closely with the Scotch sample:—

Silica	97·0
Alumina and oxide of iron ..	3·0
	100·0

The diatoms are finely preserved, the valves belonging chiefly to the elongated type; but there are a great many of a very small round species difficult to resolve. One of the best is *Pinnularia dactylus*; *Surirela eraticula* is also very abundant. Figures of these species with others which occur may be seen on page 342 of the last edition of Dr. Carpenter's work on the "Microscope," in which a woodcut is given of a very similar diatomaceous deposit from Mourn Mountain, Ireland.

The deposit from which the above sample was taken occurs on Ciste Mairearad, one of the highest of the Grampians, on the Glen Feshie side, Inverness-shire, on the estate of Sir George Macpherson Grant, of Ballin-

dalloch and Invereshie. The deposit is of unknown extent, but the sample was taken from a spot where about an acre of it is exposed, varying from 1 to 4 feet in depth, containing no stones or gravel, and very little sand.

It is not used for any purpose in the neighbourhood; the fact of there being no vegetable growth upon it, and its remarkable lightness having attracted the notice of my friend Mr. Duncan Clark, of Auchlean, Glen Feshie, to whom I am indebted for samples of it.

I hope shortly to be able to get more information concerning this deposit.

I am, &c.
[illegible] Iron Company, Sal Burn-by-the-Sea,
March 2, 1877.

TITRATION OF A MIXTURE OF ALKALINE AND OF ALKALINO-EARTHY SULPHATES.

By MM. FERD. JEAN and H. PELLET.

Let there be a mixture formed of sulphates of potassa, soda, lime, magnesia, and of alkaline and alkalino-earthy chlorides and nitrates; it is required to determine the sulphuric acid combined with alkalies and the sulphates of lime and magnesia. These determinations may be easily and exactly obtained by the use of two standard liquids, the one of sulphuric acid the other carbonate of soda, by operating in the following manner:—

1. *Titration of Sulphuric Acid Combined with Alkalies.*—The matter being dissolved in water (or in water acidulated with hydrochloric acid, if necessary) is exactly neutralised with soda in a diluted solution. To a volume of the liquid to be analysed we add a slight excess of baryta water, then seltz water, and boil it to drive away completely the excess of carbonic acid, and to render insoluble all the carbonate of baryta. We filter, and pour into the clear liquid, coloured with a few drops of tincture of litmus, standard sulphuric acid to neutralisation. The quantity of sulphuric acid employed to saturate the alkali is exactly the same as that which was originally combined with the alkalies, potash and soda.

2. *Titration of Sulphate of Lime.*—A volume of the saline solution is mixed with alcohol; the sulphate of lime precipitated is collected on a filter, washed with alcoholic water, then introduced into a Bohemian glass, or into a capsule, with a known volume of a standard solution of carbonate of soda. We raise it to a boil, then separate by filtration the carbonate of lime arising from the decomposition of the sulphate. In the filtered liquid we titrate the carbonate of soda remaining, and we have by the difference the quantity of this salt passed into the state of sulphate of soda, which is calculated as sulphate of lime.

3. *Titration of Sulphate of Magnesia.*—The solution to be analysed is treated at a boil with a known volume of a standard solution of carbonate of soda; we separate by filtration the carbonate of lime and magnesia, and we determine in the filtered liquid by the aid of standard sulphuric acid the quantity of soda not decomposed, whence we calculate the amount of sulphuric acid belonging to the sulphate of lime and magnesia. The weight of the sulphate of lime being given by the preceding operation, we find by the difference that of sulphate of magnesia.

4. *Determination of Total Sulphuric Acid.*—If in a mixture of salts we wish to titrate total sulphuric acid, free and combined, we boil the solutions with carbonate of soda, we separate the carbonates of magnesia and lime, and the liquid, filtered after having been exactly neutralised with standard sulphuric acid, is treated with baryta water, as in the titration of alkaline sulphates. This method of titration gives very exact results when we employ a solution of sulphuric acid sufficiently dilute; thus, in a mixture of salts containing total sulphuric acid 0·664 gr., we have found by our process 0·663 gr., and in 0·112 of sulphate of potash 0·110 gr.

5. *Titration of Iron Pyrites.*—We have applied this process of the titration of alkaline sulphates to the assay of pyrites. 1 grm. of the ore to be assayed is intimately mixed with about 5 parts of pure carbonate of soda, 7 parts of nitrate of potash, and 5 parts of chloride of sodium; this mixture is raised to redness in a crucible. The mass is then exhausted with boiling water, the insoluble part is separated by filtration, and after having neutralised the solution with dilute hydrochloric acid, we titrate the sulphuric acid which has passed in a state of alkaline sulphate by means of baryta water and according to the indications given above. In a pyrites containing 37·4 per cent of sulphur (weighed as sulphate of baryta) we found, by our process 34 per cent.—*Bulletin de la Soc. Chimique de Paris.*

[A process which falls short of the truth by 3½ per cent is utterly worthless from a technological point of view.—*Ed.* C.N.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 5, 1877.

Professor Odling, F.R.S., Vice-President, in the Chair.

After the announcement of visitors, the minutes of the previous, the anniversary, and the extraordinary general meetings were read and confirmed. The names of the following candidates for election to the Fellowship of the Society were read for the first time:—H. R. Hind, A. Watt, G. A. Milne, and Dr. A. E. M. Franchimont.

A lecture "*On the Discrimination of Crystals by their Optical Characters*" was then delivered by Professor N. S. Maskelyne, F.R.S., as follows:—The methods of investigation, the description of which is the purpose of the discourse, are, in their more practical aspect, *qualitative* methods. The practical application of them being that of determining the kind of symmetry which a crystal obeys, *i.e.*, the system to which it belongs. An attempt is being made, by the introduction of *quantitative* measurements into these methods, to get some insight into the nature of molecular structure. Thus far the physical and morphological properties of crystals have not been brought into very distinct correlation, and if, as is probable, the *intro*-molecular co-ordination of atoms and of groups of atoms within the unit molecule of the crystal may have to be invoked to unravel what a purely symmetrical *inter*-molecular distribution of the centres of mass of the unit molecules themselves may not be competent to explain, the result cannot fail to be of interest to the chemist, to whom the function discharged by special atom-groups in his compound molecules is becoming every day a more important question.

Reverting, however, to the practical side of the methods to be discussed, it will be seen that by a judicious use of the aid which polarised light affords, the chemist who is continually forming crystals of new and remarkable substances will be enabled to obtain rapidly valuable information about these crystals without having previously to become an adept in crystallography. The different systems of crystallography are distinguished by the character of their symmetries. For the purposes of optical comparison, as a cubical crystal acts on light as an isotropic body, we may omit the *cubical* system. The *tetragonal* and *hexagonal* systems may be grouped together. The *prismatic* or orthorhombic, the *oblique* or clinorhombic, and the *anorthic* systems will be treated of separately. The *orthorhombic* system, which may be termed the ortho-symmetrical system, has three perpen-

dicular planes of symmetry, which are not congruent, *i.e.*, with respect to which the morphological and physical characters are dissimilarly distributed. The perpendicular axes in which these three planes intersect are the morphological axes of the crystal, and are coincident in direction with the three principal axes of the ellipsoids, which represent optical, thermic, or magnetic properties. The *oblique* or mono-symmetric system has a single plane of symmetry; its normal is one of the axes of the different ellipsoids which represent physical characters, and it is also that crystallographic axis which is perpendicular to the other two. The *anorthic* or centrosymmetrical system presents the smallest amount of symmetry possible, viz., that to a centre. The repetition of any morphological element is therefore simply that of the feature presenting itself on opposite sides of the crystal.

The influence of the crystalline arrangement of the ponderable matter upon the luminiferous ether results in the elasticity of this medium varying in different directions, or in its degree of condensation being different, or in both; and it also results that the directions of elastic strain and stress only act upon the same line when that line is parallel to one of the three perpendicular directions which are called the axes of optical elasticity. While in ordinary media the direction of a ray is normal to the tangent to the front of the wave, to which the ray belongs, in the general case within the crystal the ray is oblique to the wave normal. The cases in which it is not so being those of the axes of elasticity, and certain other exceptional directions of the optic axes. As the result of the peculiar distribution of optical strains in a crystal, an ideal wave of light would, in the general case, move forward with two velocities, and would present two wave fronts, one lagging behind the other. If we consider the path of a ray belonging to any point of one of these wave fronts it will be seen that it must have bifurcated, one branch of it meeting the other wave surface; but the normals to the wave surface at the two corresponding points are connected by the fact of their being parallel to each other. The swings of the vibrations at these two points are perpendicular to each other and to the wave normal. Wire models were exhibited, in which the intersections of this wave surface with the principal sections (*i.e.*, with the intersecting planes perpendicular to each axis) were seen to compose in two cases a kind of ring, formed by a concentric circle and ellipse; in the third case the figure produced was that formed by the intersection of a circle and an ellipse, the principal axes of the ellipse being in the ratios of the greatest and of the least, while the radius of the circle represented the intermediate parameter of the three velocities along the several axes. A tangent drawn to the circle and ellipse near their point of intersection meets in the case of the circle a ray, which is coincident with the wave-normal, and the lip or margin of a conoidal depression in this part of the wave-surface is circular in form, and touched by the same tangent plane which contains the tangent to the circle and ellipse. To every point of this circle there belongs a portion of a ray, and if a section be cut in a crystal parallel to this tangent plane, these rays will emerge with a common wave front, the normal of which will now be coincident with the rays as they emerge into an isotropic medium, while the oscillations are performed in the case of each ray in a plane passing through the wave-normal and the centre of the margin circle. The light thus emerging has therefore lost its polarised character, and the direction of the wave-normal is a primary optic axis of the crystal. The radius of the circle at the point of intersection with the ellipse, where the two figures have a ray in common, is a secondary optic axis. From the symmetry of the figures there are two primary axes, differing in the angles which they enclose, according to the ratios of the three constants representing the velocities along the three axes. These three axes will now be called the two mean lines and the normal. The *first mean line* bisects the acute angle between the optic axes, the *second mean line* bisects the obtuse angle, the *normal line* is that axis which is perpendicular to the other two. The orientation of the mean lines, *i.e.*, their relative situations in parallelism to one or another crystallographic axis is the first problem in the study of the optical characters in a crystal. Next we have to determine the angle between the optic axes, and here the dispersion, *i.e.*, the difference of angle for different colours, has to be taken into account. In connection with the first of these problems we have to contemplate the cases in which the angle between the optic axes becomes *nil*; the axes themselves coinciding with the first mean line. Let, for instance, $a=b$ (where a, b, c are the three velocities represented in the order of magnitude). In this case then the ellipse has b and c for the ratios of its principal axes, the radius of the circle being represented by b; the wave-surface then becomes defined by a sphere, and a prolate spheroid touching the sphere internally, the common axis of the two figures being on the axis of least velocity. This, then, would be a uniaxal crystal, positive in optical character, the ordinary ray being the quicker, and represented by the (external) sphere. Where $c=b$ the crystal is negative, the common axis is that representing the greatest wave-velocity; the ellipse is external to the sphere and the ordinary becomes the slower wave. So, too, a biaxal crystal will be conventionally termed positive or negative according as its first mean line coincides with the axis of least or greatest elasticity. Returnnig to the subject of dispersion, it was shown that this character presented itself under two conditions: one, in which the directions of the axes of wave-velocity were the same for all colours; the other, in which the directions of those axes were not coincident. Without entering upon an explanation of the beautiful isochromatic curves, and the black cross or black hyperbolas intersecting the optic "eyes" of a crystal when examined in a polarising apparatus, it was shown that, whereas in the case of the plane containing the optic axes lying in or being perpendicular to the plane of polarisation, the figure for any one colour —say red—would be black at the point of emergence of an optic axis, but red around it, and then rings alternately *black and red* in the case; of the plane being at an angle of 45°, the axial point would be red surrounded by a black ring, and then rings alternately *red and black*. The result of this last case is, that if the blue "eyes" were external to the red, the "eye" which is black, as far as the red is concerned, would be illuminated by the first blue ray, &c. Whence the character of the dispersion may be predicated as being in the inverse order of the colours which fringe the hyperbolas on their inner and outer edges as they traverse the "eye" of the section.

As to the kind of symmetry which crystals may present it will be obvious that, in the ortho-rhombic system, dispersion of the optic axes is alone possible, the mean lines necessarily coinciding in direction with the crystallographic axes. Thus sections of crystals of cerussite, arragonite, and barytes were exhibited on the screen by means of the electric light and polarising apparatus, the first illustrating the case where the red rays are more dispersed than the blue, whilst in the second and third the blue rays are more dispersed than the red. Sections of Brookite and ammonic-magnesic-chromate were shown, to illustrate the case of crystals in which the first mean line for red coincided with one axis, that for bluen with a axis perpendicular to it. In the oblique system, with its single plane and single axis of symmetry, the conditions for dispersion are more widely varied: in this system, besides the dispersion of the optic axes, we have three kinds of dispersive distribution of one or other of the mean lines:—1. The first mean line may coincide with the axis of symmetry, the second mean line and normal line lying in the plane of symmetry in which they may be distributed. This is tne *crossed dispersion* of Des Cloizeaux: it was illustrated by a section of a crystal of borax; the isochromatic figures in this case are centro-symmetrical. This may be termed *centro-symmetrical dispersion*. 2. The second mean line coincides with the axis of sym-

metry, the first mean line being distributed in the plane of symmetry. In this case the figures presented are symmetrical to a line perpendicular to the line that would join the optic axes for any particular colour. It is the horizontal dispersion of Des Cloizeaux. It was illustrated by Adularia. It might perhaps be more correctly called *perpendicular dispersion*. 3. The first and second mean lines are distributed in the plane of symmetry; the figures are in this case symmetrical to the line passing through the centres of all the "eyes," which is the trace of the plane of symmetry. This is the *inclined dispersion* of Des Cloizeaux, and might be called *enthysymmetrical dispersion*. This variety was illustrated by a section of gypsum, and the effect of heat in changing the character of the dispersion into a dispersion of the horizontal kind was most beautifully shown, the optic axes closing in upon the centre of the figure, but unsymmetrically, by reason of the axial dispersion, and then opened out again along a line perpendicular to their former direction. In the anorthic system, where there is no coincidence of the mean lines with any crystallographic axis, either of the kinds of dispersion last described may concur together with axial dispersion.

The lecturer then proceeded to discuss the mode of determining the symmetry or system of a crystal by finding the directions in it, or in sections cut from it, in and perpendicular to which light vibrations will be performed,—*i.e.*, the determination of the directions of maximum darkness, when the crystal or the section is turned round between crossed Nicol's. The first thing to know is the plane of polarisation of the entering light, which we will suppose to be indicated by a vertical spider-line in the eye-piece of a microscope. A minute crystal or crystals may now be placed on the stage of the microscope, and the stage revolved until the light ceases to pass through one or other of the crystals. With the aid of a rotating spider-line and a graduated circle, the direction of any of the edges of the crystal may now be determined in respect to the vertical spider-line,—*i.e.*, in respect to the directions of the principal sections of the particular section of the crystal. By comparing the results obtained in this way from the various crystals with the kinds of symmetry which prevail in different systems, it is often possible to determine the system to which the crystals belong. When we are dealing with crystals in which the optical characters have been determined, it is generally possible to identify the substance, provided its crystallography and optical characters have been well studied. A beautiful application of this principle in the latter form is that by which Des Cloizeaux discriminated between the felspars, by determining the angle in which the trace of the plane of the optic axes intersects with the edge formed by the planes of clearage. Sections of the felspars were exhibited on the screen, including some of microline, the felspar in which Des Cloizeaux has recently recognised a potash isomorph of albite, so that the potassium felspar is now known to be dimorphous. The method of determining the exact position of maximum darkness in a section or a crystal has recently been greatly enhanced in delicacy, by M. Emile Bertrand, by means of a quadrant biquartz plate, with the aid of which the slightest deviation to right or left of the crystal from its true position imparts tint to the little plate which is placed in the focus of the eye-piece. This instrument was exhibited on the lecture-table.

Prof. Odling, in proposing a vote of thanks (which was carried by acclamation), said that the Fellows must feel greatly obliged to Prof. Maskelyne for his endeavours to re-associate chemistry and crystallography, and all must have appreciated the lucid and earnest lecture as well as the novel and beautiful illustrations.

In his reply to the unanimous vote of thanks, Professor Maskelyne mentioned that a Crystallological Society had been formed to carry out some of the objects which he had mentioned in his lecture. It consisted of chemists, to make suitable groups of crystals, and of crystallographers, to examine the crystals when made.

The Society then adjourned to Thursday, April 19th, when the following papers will be read: "On the Estimation of Manganese in Spiegeleisen, and of Manganese and Iron in Manganiferous Iron Ores," by E. Riley. "On certain Bismuth Compounds," Part V., and "On a Method for Detecting Small Quantities of Bismuth," by M. M. Pattison Muir.

CORRESPONDENCE.

ELECTRO-DEPOSITION OF ALLOYS.

To the Editor of the Chemical News.

Sir,—By working an electro-brassing solution that contains cyanide of potassium and tartrate of ammonium at very little above the freezing-point, nearly pure zinc is obtained on the negative plate; as the heat increases the deposit changes in tint, and at one degree of heat it becomes of a perfectly silvery hue. On still raising the heat the deposit becomes yellow in colour.

The zinc-copper alloy of a silvery hue may or may not have some relation to Lavœsium.—I am, &c.,

W. H. Walenn.

74, Breckrock Road, N., April 7, 1877.

MOSS COPPER, &c.

To the Editor of the Chemical News.

Sir,—With reference to the the letters which have appeared in the Chemical News under this heading I can quite corroborate the remarks of Mr. T. A. Readwin. Early last year I had an opportunity of seeing Mr. Readwin's remarkable collection of British gold specimens at his house, when he was kind enough to show me a vast number of specimens, in which the gold was manifestly "growing" from the pyritous and siliceous matter with which it was associated.

Mr. Readwin then gave me a specimen of argentite from his cabinet, which was sending out wiry shoots of metallic silver. I placed this in a glass-topped box considerably larger than the specimen. I now find—April, 1877—that the silver has "grown" upwards to such an extent that it is flattened against the glass of the box, like the nose of a city arab against the window of a cookshop.

Many of my friends here have observed similar phenomena of mineral growth.

The whole subject of the relations of time to the formation of minerals is most interesting, and it would very much assist this important line of investigation if collectors would narrate their experience.—I am, &c.,

J. H. Collins.

Truro, April 7, 1877.

SUPPOSED DELETERIOUS INFLUENCE OF MOONLIGHT ON ANIMAL FOOD.

To the Editor of the Chemical News.

Sir,—While on a voyage up the Mediteranean I remarked the care the sailors took to remove out of the moonlight some pilot fish which had been caught and were being exposed in order to cure. On expressing astonishment, I was assured that the moonbeams had the property of rendering meat and fish poisonous. All the crew were unanimous in this opinion, and the captain (an old salt) went so far as to give instances from his experience—particularly one case, in which one of his crew became so

seriously unwell that his life was despaired of, his illness being unhesitatingly ascribed to his having eaten fish that had been exposed to the moon's influence. The symptoms as detailed were undoubtedly those of poisoning, but it occurred to me that they might be due to salts of copper having found their way into the food or water, as occasionally happens on long voyages from the condenser becoming foul. This, however, was a sailing vessel, and as they did not distil their water supply, the chances of contamination in this manner were fewer. Can any of your readers say if there are any physiological grounds for this belief, or if not suggest an origin of this curious superstition?—I am, &c.,

SELENE.

March 30, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 13, March 26, 1877.

Presence of Benzol in Coal-gas.—M. Berthelot.—The author considers that the illuminating power of Paris coal-gas is mainly due to the vapour of benzol, the presence of which he shows at some length. Other liquefiable hydrocarbons are found in much smaller proportions.

Recent Communication by M. Weddell concerning the Advantage of Substituting Cinchonidin for Quinine.—M. Pasteur.—The author disclaims the discovery of cinchonidin, which had been attributed to him by M. Weddell.

Digestion of Albumen.—M. P. van Tieghem.—This is a botanical paper, relating to the germination of seeds.

Theory of Frigorific Machines.—M. A. Terquem.—A mathematical paper, not suited for abstraction.

Reflection of Polarised Light.—M. Crouillebois.—The same remark applies to this paper.

Transformation of Crystalline Sugar into Inactive Glucose in Crude Cane-sugars.—M. U. Gayon.—The reducing sugar present in crude cane-sugars is a glucose without action upon polarised light. The transformation in question is due, not to the acidity of the sugars, but to a real fermentation.

Composition of Gun-cotton.—MM. P. Champion and Pellet.—The authors seek to show that gun-cotton, as prepared by Prof. Abel's process, is a pentanitrated process, and not, as generally considered, trinitro-cellulose.

Series of Quinolines: Transformation of Leucoline into Aniline.—J. Dewar.—Not suitable for abstraction.

Nitro-toluquinon and Chloranilic Acid.—M. A. Etard.—Nitro-toluquinon is obtained by the action of chloro-chromic acid upon nitro-toluen. It is, in the opinion of the author, the first in the series of the cresylic quinons.

Sewage of Paris.—M. Ch. Lauth.—The author has analysed some sewage, determining the organic nitrogen in the soluble and insoluble portions by the soda-lime process. He states that if filtered the sewage may be preserved for two months without the production of any offensive odour. He has also experimented on the treatment of sewage by air and by the lime process.

Antiseptic Properties of Bichromate of Potassa.—M. Laujorrois.—The author finds that beer mixed with 1-1000th part of bichromate does not turn sour. Meat, gelatine, and vegetable matters can be preserved by its agency, even if freely exposed to the air. He found, however, that dogs—very judiciously in our opinion—declined to eat meat thus preserved.

Bulletin de la Société Chimique de Paris, No. 3, February 5, 1877.

Researches on Melezitose.—M. A. Villiers.—Melezitose is a variety of sugar obtained from *Alhagi maurorum*, a leguminous shrub found in Persia and India, in the exudations of which this compound is found along with cane-sugar. It is dextro-rotatory, and in an anhydrous state requires the formula $C_{24}H_{22}O_{22}$.

Remarks on the Preceding Communication, and on the Constitution of Sugars Isomeric with Cane-Sugar.—M. Berthelot.—The author considers it useful to point out that theory pre-indicated the existence of several isomeric saccharoses derived from one and the same glucose, and capable of reproducing it.

Purification of Valeric Acid.—M. Lescœur.—The author forms an acid valerate by dissolving one of its neutral alkaline salts in rather more than two equivalents of the crude acid, crystallising, draining the crystals first on porous tiles, and then pressing between folds of blotting-paper. The crystals are then decomposed by treatment with luke-warm water, when valeric acid is liberated as an oily layer.

Precipitation of Phosphoric Acid by Ammonia in Presence of Lime, Baryta, Magnesia, Alumina, and Ferric Oxide.—M. H. Pellet.

Determination of Alumina and Ferric Oxide in Presence of Phosphoric Acid.—M. H. Pellet.—These two papers will be inserted in full.

Solubility of Certain Salts of Cadmium and others employed in Photography.—M. J. M. Eder.—This paper, abridged from *Dingler's Journal*, consists essentially of a table of solubilities.

Influence of Silica on the Determination of Phosphoric Acid by the Molybdate of Ammonia.—M. E. H. Jenkins.—In this paper, taken from the *Journal für Praktische Chemie*, the author maintains that the presence of silica does not interfere, as usually supposed.

Absorption of Ammoniacal Gas by Sulphate of Lime.—M. E. H. Jenkins.—The author finds that anhydrite does not absorb ammoniacal gas at ordinary temperatures, at 50° or at 100°. The same holds good with natural gypsum and with calcic sulphate, whether precipitated from a hot or a cold solution. If the same substances have lost a part of their crystalline water they absorb small quantities of ammonia, the proportion increasing with the temperature.

Pennsylvanian Gas-Springs.—J. Lawrence Smith.—The author, in a paper contributed to the *Annales de Chimie et de Physique* (viii., 566), describes certain wells, one of which discharges a million cubic feet of lighting-gas per hour. Its value is equal to seven standard candles, and it contains a little carbonic oxide and carbonic acid.

Remarks on the Effect of Acids upon Vegetable and Animal Fibre.—M. J. Weissner.—The author shows that vegetable fibre (mixed, *e.g.*, with wool) may be completely destroyed by steeping for an hour in water containing from 1 to 2 per cent of sulphuric acid, and subsequent exposure to a temperature of 50° to 60°. Animal fibre, on the contrary, is strengthened by a similar treatment with water containing from 3 to 4 or 5 per cent of acid, and subsequent exposure to a heat of 60° to 65°. If the acid liquid is stronger, containing 7 or 8 per cent, the fibre is weakened.

Preparation of Anthraquinon by the Action of Chloride of Lime and a Metallic Salt upon Anthracen.—M. A. Henniges.—On mixing anthracen with manganous chloride and chloride of lime there is precipitated manganic oxide, which oxidises the anthracen to anthraquinon. In three hours the reaction is complete; the

manganese is removed by means of an acid, and the anthraquinon is purified by sublimation. But it still contains 18 per cent of chlorine. If chloride of platinum is used instead of that of manganese, the product contains 12·25 per cent of chlorine, and if chloride of cobalt be employed we find merely 2 per cent. The chlorine thus present is not combined with the anthraquinon, but belongs to a secondary product. Certain metallic salts convert anthracen directly into anthraquinon. We obtain the latter compound by moistening with water a mixture of equal parts of anthracen and ferric chloride, heating to 100°, and adding from time to time a little water. After twenty-four hours the product is washed with acidulated water, which leaves crude anthraquinon. Thus 100 grms. of sublimed anthracen gave 116 grms. of crude anthraquinon, which latter yielded 9·6 grms. of sublimed anthraquinon. Nitrate of iron acts in an analogous manner, 10 grms. of anthracen producing 3 grms. of sublimed anthraquinon. Lastly, the author arrived at the same result by digesting the anthracen with peroxide of manganese and sulphuric acid, diluted with an equal volume of water. The reaction begins spontaneously, but it requires to be completed by keeping the mixture in the water-bath. The product thus obtained is purer and more abundant than that yielded by the methods previously mentioned.—*Dingler's Journal.*

Biedermann's Central-Blatt für Agricultur Chemie,
Heft 1, 1877.

Concentrated Molasses Waste as a Dressing for Soils that are "Turnip-Sick."—F. E. Schoch, Prof. Märcker, and Dr. Heidepriem.—The treacle from beet-root sugar works is chiefly converted into alcohol, and the residue, containing the salts and nitrogenous matter, has been very successfully used on turnip-sick soils.

Action of Phosphates upon Calcareous Soils.—E. Damourette.—Contrary to the author's expectations phosphates gave upon these soils a better result than nitrogenous manures, the action of sulphate of ammonia alone being rather injurious. Superphosphate produced a gain, which may be represented by the figures +134, and sulphate of ammonia a loss corresponding to −31.

Substitute for Animal Charcoal.—Dr. Melsens.—The author steeps wood in the waste liquor of gelatine works (a solution of phosphate of lime in muriatic acid) or in solution of sulphate of magnesia, and then carbonises. The charcoal thus obtained has great decolourising power.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 37, January, 1877.

This issue contains no chemical matter.

Gazzetta Chimica Italiana.
Anno vii., 1877, Fascicolo i.

Certain Paraffins and other Homologous Hydrocarbons found in a Specimen of Lava from Etna.—Prof. Orazio Silvestri.—In the lava of a certain district, about 22 kilometres in a direct line from the great central crater of Etna, the author finds a solid crystalline matter, easily fusible, a heavy reddish brown oil, solidifying below 0°, sulphur crystallising in monoclinar prisms, and a further quantity of sulphur forming trimetric octahedra.

Normal Propyl-benzol and Propyl-phenol.—E. Paterno and P. Spica.—Not adapted for abstraction.

Preliminary Note on the Derivatives of Naphthalin.—J. Guareschi.—The author treats of nitro-naphthalin, nitro-naphthalic acid, dinaphthyl, and bromo-binitro-naphthin.

Chemical Constitution of Benzol, Phenol, and some of their Derivatives.—H. Kolbe.—A paper translated from the *Journal für Praktische Chemie*, combatting the hypothesis of Kekulé on the constitution of these bodies.

Reimann's Färber Zeitung,
No. 12, 1877.

The only important paper in this issue is a notice of chrysoidin, taken from the *Berichte der Deutschen Chem. Gesellschaft.*

Les Mondes, Revue Hebdomadaire des Sciences,
No. 12, March 22, 1877.

This issue contains no chemical matter. The attack on the astronomer Flammarion is resumed, and the orthographical controversy, granite or granit, is still raging.

Royal Institution.—Mr. James Dewar, F.R.S.E., Jacksonian Professor of Natural Experimental Philosophy in the University of Cambridge, has been elected Fullerian Professor of Chemistry in the room of Dr. Gladstone, resigned.

MEETINGS FOR THE WEEK.

MONDAY, April 16th.—Medical, 8.
Society of Arts, 8. (Cantor Lectures). "The Connection of Greek and Roman Art with the Teaching of the Classics," Sidney Colvin, M.A.
TUESDAY, 17th.—Civil Engineers, 8.
— Zoological, 8.30.
— Royal Institution, 3. "Chemistry of the Heavenly Bodies," Prof. Gladstone.
WEDNESDAY, 18th.—Society of Arts, 8. "The Modification which Ships of War have undergone during the last Twenty Years," E. J. Reed, M.P., C.B., &c.
— Meteorological, 7.
THURSDAY, 19th.—Royal, 8.30.
— Society of Arts, 8. (Chemical Section). "Spontaneous Combustion in Factories and Ships." C. W. Vincent, F.C.S., F.R.S.E.
— Royal Institution, 3. "Heat," Prof. Tyndall.
— Chemical, 8. "Estimation of Manganese in Spiegeleisen, &c." E. Riley. "On Bismuth Compounds, Part V.," and "On a Method for Detecting Small Quantities of Bismuth," by M. M. Pattison Muir.
FRIDAY, 20th.—Royal Institution, 9. "Spinoza," Mr. F. Pollock.
— Society of Arts, 8. (Indian Section). "The Existing and Possible Commercial Communications between Persia and India," Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.
SATURDAY, 20th.—Royal Institution, 3. "Babylonian Literature," Rev. A. H. Sayce.

THE
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THE CHEMICAL NEWS.

VOL. XXXV. No. 908.

ON THE NEW METAL—GALLIUM.*

By M. LECOQ DE BOISBAUDRAN.

(Continued from p. 100.)

III. *Properties of Pure Gallium.*—Gallium is a greyish white metal having a fine lustre, but tarnishing slightly in moist air on account of superficial oxidation. The colour and brilliancy are notably diminished as soon as the metal begins to solidify. In a liquid state (in superfusion for example) it is of a beautiful silvery white, but if any part of its surface comes in contact with a trace of solid gallium a spot is seen to form which rapidly spreads; and on crystallising it assumes a very decided bluish tint, and its lustre diminishes. Gallium is liquefied by the heat of the hand.

On a first trial made in April, 1876, the point of fusion was found to be between 29° and 30°—say about 29·5°. I have just tested† six samples of gallium deposited successively from one and the same solution. Under such conditions the presence of foreign metals would be shown by the difference in the fusibility of the various fractions collected. The following are the numbers I obtained:—

	Points of Fusion
Gallium No. 1	+ 30·14°
,, ,, 2	+ 30·16°
,, ,, 3	+ 30·14°
,, ,, 4	+ 30·15°
,, ,, 5	+ 30·16°
,, ,, 6	+ 30·16°
	+ 30·15°

This gallium appeared then to be very pure. In order to satisfactorily prove that traces of potassium did not contribute to the great fusibility of gallium I placed the sample No. 4 in boiling water for two hours. The metal was reduced to powder consisting of a multitude of very minute globules, which were united, not without some loss, by compression under warm water. The fusion-point of the small mass thus obtained had not varied in the slightest degree, consequently the gallium contained no potassium. The six samples of gallium having been mixed, a fragment weighing 2½ centigrammes, was kept for half an hour in nitric acid diluted with its own volume of water. The temperature varied from 60° to 70°. The loss did not amount to 1 milligrm., including the small globules which had escaped when the metal was united into one mass. The fusion-point had not varied during this operation, for the metal melted *very slowly* at +30·16°, and solidified *very slowly* at +30·06°. When it has been completely melted gallium is very readily kept in superfusion. This explains how it is that a globule remained liquid for several weeks at temperatures falling occasionally almost to zero.

The superfusion of gallium ceases on coming into contact with the smallest particle of the same solid metal. It is interesting to notice that gallium preserves its liquidity, whether on plates of platinum or after contact and repeated rubbings with a steel rod.

When the solidification of a rather large mass of superfused gallium* is effected and placed in a room kept a few degrees below 30°, it is observed that the metal possesses a marked tendency to crystallise. If it is afterwards dissolved in dilute hydrochloric acid, not only does it assume a crystalline and shining texture, but broad and well-defined surfaces are developed, which makes the whole mass look at times like a single crystal. I have recently succeeded in preparing metallic gallium in the form of based octahedra, which I am occupied in measuring. Once solidified, gallium is hard and resistant, even at a few degrees below its fusion-point. It can, nevertheless, be cut, and is flexible and malleable. At about 30°15°, gallium adheres to glass, on which it forms a fine mirror, which appeared to me whiter than that produced by mercury. With warm water the gallium is easily detached from the glass.

The surface of the metal in fusion is soon covered with a pellicle of metallic appearance, but doubtless formed of oxide, under which a little wave, very mobile, is seen to pass when the vessel is leaning.

Heated to bright redness in presence of air gallium does not volatilise, and only oxidises very superficially. When cold the metal has only to be rubbed with a rod to restore its original brightness.

If a sheet of platinum covered with gallium is heated to redness, the latter becomes alloyed with it, and resists the action of hydrochloric acid; it is, however, dissolved with weak aqua regia together with traces of platinum. At the same time a slight whitish pellicle is detached, formed, probably, of oxide of gallium, which calcination renders difficultly soluble in acids. The solution in aqua regia gives the spectrum of gallium.

In May, 1876, I tried to determine approximatively the density of the new metal on a sample weighing 64 milligrms. I obtained 4·7 at 15° C. with reference to water at the same temperature. The mean specific gravity of aluminium and indium being about 4·8 at 0°, that found provisionally for gallium seemed to agree tolerably well with a theory which would place the new metal between indium and aluminium. However, the calculations established by M. Mendeleef for a hypothetical body which seems to correspond to gallium, at least in its general properties, point to the number 5·9.

As soon as I had prepared a fresh supply of pure gallium I continued my researches as to its density, and I found that gallium crystallised under water, decrepitates sometimes when heated, which leads me to think that in my first experiment the metal perhaps contained interstices filled with air or water. I am ignorant whether this cause of error combined with others to falsify my first determination. However this may be, I avoided it afterwards by subjecting the metal to a strong heat, and solidifying it in a dry atmosphere. By these means I obtained higher densities, varying from 5·5 to 6·2, although the samples experimented with did not weigh more than a few centigrammes.

I then operated on a single ingot of pure gallium weighing about 58 centigrms., formed by the union of the six samples mentioned above. The density of this ingot I found to be at +23° (and referred to water at +23°)—

First experiment	5·900
Second experiment	5·970
Mean	5·935

M. Mendeleef's prevision is thus completely verified.

The same gallium was afterwards maintained for half-an-hour between 60° and 70° in nitric acid diluted with its own volume of water, then washed, very strongly heated, and finally solidified in dry air. The following are the results of this experiment:—

* Communicated by the Author.

† As it is rather difficult to fix upon the precise instant in which the minute masses of gallium show the first signs of fusion, I think that +30·15° is by a few centièmes rather over than under the true point of fusion.

* Some centigrammes at least.

Tare of the flask full of water ..	24·27905 grms.
Tare of the flask with gallium ..	23·80155 ,,
Increase of weight	0·47750 ,,
Weight of dry metal	0·57385 ,,
Water expelled	0·09635 ,,

$\frac{0{\cdot}57385}{0{\cdot}09635} = 5{\cdot}956$ at the temperature of +24·45°.

The action of the nitric acid having altered neither the fusion-point nor the density, my present gallium may be considered very pure.

The flask which had just been used for the preceding determination was placed for a few minutes (with the gallium it contained) in a water-bath at 50° or 60°, and then cooled. The metal remained in superfusion, its density being taken as follows:—

Tare of the flask full of water ..	24·27920 grms.*
Tare of the flask with metal ..	23·79990 ,,
Increase of weight	0·47930 ,,
Weight of dry metal	0·57385 ,,
Water evaporated	0·09455† ,,

Thus liquid gallium appeared to be rather denser than solid gallium. Further experiments are, however, required to settle this question, for it is possible that the solid metal may still have contained some pores or cavities which disappear when it is melted. The difference observed is scarcely beyond the limits of error liable to be made with the imperfect apparatus at my disposal.

Gallium is dissolved in the cold, and more rapidly by the application of heat in hydrochloric acid, hydrogen being rapidly evolved. It is not sensibly attacked in the cold by nitric acid, but with the aid of heat it dissolves, with the evolution of rutilant fumes. A solution of caustic potassa dissolves gallium with the evolution of hydrogen. This observation was made by M. Fremy.

The gallium electrolysed by an ammoniacal solution is identical with that obtained by means of a potassic solution. The differences I at first noticed were owing—(1) to the presence of traces of foreign metals; (2) to the effects of superfusion presented by the gallium. It is impossible to determine at present the uses to which the new metal will be put in science and commerce, but it is easy to foresee that its very exceptional properties will be utilised for purposes for which the other metals are unsuitable.

IV. Spectrum of Gallium.

The most remarkable reaction of gallium is the formation of two beautiful violet rays when the surface of a saline solution of that metal is submitted to the action of the induction spark. These two rays have all the characteristics of rays produced by the metal itself, and not by one of its compounds. To obtain a fine electric spectrum of gallium, the exterior positive conductor must not be brought too near the negative solution: a very short spark should not be used, but one of medium length, *i.e.*, about 1½ to 2 millimetres.

On introducing the chloride of gallium into a gas-flame only a feeble and fugitive trace of the least refrangible violet ray is observed. This method, though an excellent one for alkalies, indium, thallium, &c., cannot be employed in researches connected with gallium.

* Taken immediately after the gallium had been taken away.

† The weights relating to the density of liquid gallium were taken only once, while for solid gallium they were each taken twice, and the mean of the two numbers obtained was employed. Upon the whole, the experiment with solid gallium was performed under rather better conditions.

*Electric Spectrum of the Chloride of Gallium.**

Position on my Micrometer.	λ.	Observations.
α 193·72	417·0	Narrow; *strong*; decidedly more brilliant in a spark of mean length than in a very short one.
β 208·90	403·1	Narrow; well marked; but much weaker than α 193·72. Much brighter with a medium than with a very short spark.

The ray Gaα 417·0 is characteristic of gallium, and is a very sensible reaction. The gallium spectrum is, however, less brilliant than that of indium. I have not observed any other rays that I can *with certainty* attribute to gallium; those I have perceived are weak under the conditions in which I work, even with concentrated chloride of gallium. I am still pursuing the subject.

V. Action of Some Reagents on the Compounds of Gallium.

1. *Metallic Zinc.*—So long as the liquids are sensibly acid, and the evolution of hydrogen goes on actively, zinc does not precipitate either the chloride or sulphate of gallium, but when the liquids become basic, and hydrogen is evolved very slowly, the oxide of gallium (or more probably a sub-salt) is separated in white flakes mixed with sub-salts of zinc.‡ If there be any alumina it is found in the same deposit as the gallium. It is, then, in reality a sub-salt of zinc previously formed which precipitates the gallium: so, to render the latter insoluble, the gallium solution of chloride of zinc must be heated up to the point when, hydrochloric acid being expelled, it has become basic. The concentrated liquid may still be limpid, but if it is diluted with a great deal of water it yields oxychloride of zinc, and with it oxide of gallium. The precipitation of oxide of gallium by zinc is rather slow in the cold. In small volumes it takes a few days, but in a large volume it is scarcely completed in less than three weeks or a month, according to the season. At a temperature equal to boiling-point only a few hours are required.

2. *Cadmium.*—A sheet of cadmium precipitated nothing from a solution of chloride of zinc rich in gallium, even after boiling for a long time.

3. *Ammonia.*—An excess of this reagent precipitates gallium salts, of which a notable proportion remains in the liquid, notwithstanding the presence of ammoniacal compounds. By dissolving with hydrochloric acid the part not dissolved by an excess of ammonia, and re-commencing the operation, all the gallium in ammoniacal solution is promptly obtained. The solubility of the oxide of gallium in ammonia exceeds that of alumina under the same circumstances,§ for when a mixture of chlorides of aluminium and gallium is treated several times with an excess of ammonia, the first of the ammoniacal solutions becomes very rich in gallium, and the last of the precipitates consists exclusively of alumina. A single precipitation by means of a large excess of ammonia is sufficient to yield, on the one hand, a gallium salt poor in aluminium, and, on the other, alumina containing little gallium. When ammonia is added drop by drop to some chloride of zinc

* The relative intensities indicated in this description relate to the mean concentration of the solution employed for the execution of the present drawing.

† The ray Gaβ is more difficult to measure than Gaα; I do not, however, think that the error in λ much exceeds 0·1. The wavelengths found by MM. Delachanal and Mermet are Gaα=417·1 and Gaβ=403·3. (*Bulletin de la Société Chimique de Paris*, March 5, 1876.)

‡ The metals precipitated by the zinc of a solution rich in gallium contain very sensible traces of that body. Does it exist in the state of oxide confined in the metallic sponge, or is it reduced in small quantity by being *drawn down*? In any case it suffices to re-dissolve the metals, and to repeat the reduction by zinc in order to eliminate the little gallium contained in the first deposit.

§ It is known that to make a good precipitation of alumina by ammonia the liquor must contain ammoniacal compounds. All chemists do not, perhaps, take into consideration the relatively large quantity of alumina which is dissolved in very pure ammonia. Such a solution precipitates *abundantly* when a few drops of solution saturated with an ammoniacal salt are poured into it.

containing a little gallium, the latter is precipitated before the zinc, and is rapidly concentrated in the first deposits. The liquid seems not to contain any appreciable quantity of gallium.

4. *Carbonate of Ammonia.*—This salt behaves in many respects like free ammonia. It dissolves oxide of gallium. At present I have not well studied its action.

5. *Fixed Caustic Alkalies.*—A small quantity of potash precipitates the oxide of gallium, and acts then like ammonia, but the precipitate is extremely soluble in an excess of the reagent.

6. *Alkaline Carbonates.*—If carbonic acid gas is made to pass into the potassic solution of oxide of gallium, the latter is separated again; it is then easily soluble in dilute sulphuric and dilute hydrochloric acids, as well as in dilute potassa. Carbonate of soda precipitates gallium salts in the cold and by the aid of heat. When a gallium chloride of zinc is treated fractionally with carbonate of soda, the gallium is concentrated in the first deposits. The separation is so complete that one of the precipitates may give the gallium rays much more brilliant than those of zinc, whilst the next shows a feeble image of the ray Gaα 417·0 and a bright spectrum of zinc. At a temperature equal to the boiling-point a very small quantity of carbonate of soda forms a thick precipitate in the gallium salts, which is re-dissolved as the liquor cools. This effect is due to the decomposition by hot water of some neutral salts of gallium, and to the combination of their elements on cooling. Alumino-ammoniacal alum, with or without the addition of acid acetate of ammonia, does not become turbid when boiled, whilst ammonio-gallic alum is strongly so, as will be seen further on. In a fractional precipitation oxide of gallium (or a sub-salt of that metal) ought to be deposited before the alumina. This conclusion seems to be justified by experiment. If a mixture of salts of aluminium and gallium, in very small proportions, is precipitated by carbonate of soda, the rays Gaα 417·0 and Gaβ 403·1 are most intense in the first product, and afterwards go on diminishing; still we cannot in this manner arrive at a satisfactory separation of gallium and aluminium. Carbonate of soda only precipitates indium after gallium.

7. *Acetic Acid.*—The chloride and sulphate of gallium, slightly acid, are not precipitated by acid acetate of ammonia in the cold, but by the aid of heat the reaction takes place. The precipitate is in white gelatinous flakes, and is not dissolved in the presence of a moderate excess of acetic acid, even on boiling. However, if a large quantity of acid acetate of ammonia or acetic acid is added, the liquor remains limpid when heated. The neutral sulphate of gallium becomes turbid in the cold, when a little acid acetate of ammonia is poured into it; but a large quantity of the same reagent renders the liquid clear in the cold, and in that case it no longer grows turbid on heating unless water is added. An ammoniacal solution of sulphate (or chloride) of gallium is precipitated, both in the cold and in the heat, by an excess of acetic acid. This effect, however, ceases if the liquid be very dilute, or if the excess of acetic acid be very large.

8. *Sulphuretted Hydrogen.*—Slightly acid solutions of chloride and sulphate of pure gallium are not rendered turbid by sulphuretted hydrogen. Even in the presence of acid acetate of ammonia no precipitate is formed. The reaction of hydrosulphuric acid is quite different when the solution of gallium contains zinc. It is well known that the salts of zinc (chloride, sulphate, &c.), very slightly acid, are precipitated by sulphuretted hydrogen: the action is limited by the quantity of strong acid set at liberty. If the experiment is made with a chloride of zinc containing gallium, a notable quantity of this metal falls along with the sulphide of zinc. The precipitation of gallium is easier, without, however, being quite complete when the liquid rich in zinc is supersaturated with acid acetate of ammonia. If the salts of zinc are not sufficiently abundant to draw down at once the whole of the gallium precipitable by sulphuretted hydrogen, it must be added in small portions until these products no longer give the ray Gaα 417·0 in the spectroscope. Only very faint traces of gallium then remain in the liquid. In a mixture containing much chloride of zinc, notably of chloride of indium and chloride of gallium, the fractional precipitation, by means of sulphuretted hydrogen in the presence of acid acetate of ammonia, gives successively—

1. Much indium, a moderate quantity of zinc, traces of gallium.
2. A moderate quantity of indium, much zinc, considerable quantity of gallium.
3. Traces of indium, much zinc, considerable quantity of gallium.

The precipitation of sulphide of gallium* effected in the presence of salts of zinc offers a rather curious instance the effects which are produced in a very large number of chemical reactions, and which cannot be neglected in such researches as the present. If the precipitates of sulphides, obtained by successive addition of chloride of zinc to a solution rich in gallium, are examined by the spectroscope, it will be seen that they appear to remain at first almost constant, or at least to decrease slowly, then more and more rapidly until the ray Gaα 417·1 is no longer visible. Thus the quantity of gallium precipitated by sulphide of zinc does not seem to be a function of the richness of the liquid. Within certain limits it seems to be almost in proportion to the amount of sulphide of zinc formed. Is there not here an indication of a combination between the two substances, or perhaps more probably a surface-attraction analogous to the fixation of a colouring matter upon a mordant?

9. *Hydrosulphate of Ammonia.*—In the presence of salts of zinc, gallium is precipitated as much in neutral or acid solutions as in ammoniacal liquids. An excess of hydrosulphate of ammonia does not re-dissolve the gallium, unless, indeed, the sulphide of zinc be in such small quantity as to dissolve also.† If a neutral or slightly acid solution of zinc and gallium is treated with hydrosulphate of ammonia containing free ammonia, the gallium is concentrated on the first sulphides of zinc. If, instead of being neutral or acid, the solution of zinc and gallium is ammoniacal, the gallium is concentrated in the last sulphides. Hydrosulphate of ammonia does not precipitate an ammoniacal solution of chloride or sulphate of *pure* gallium.

10. *Carbonate of Barium.*—This reagent precipitates the oxide of gallium in the cold. I employed this method in my first researches to eliminate the greater part of the zinc with which any chloride of gallium was alloyed, but the separation is less complete than when submitted to fractional precipitation with carbonate of soda, for the carbonate of barium retains a considerable quantity of zinc with the gallium.

11. *Aqua Regia.*—Repeated evaporations with large excesses of aqua regia appear to occasion no loss of gallium by volatilisation of chloride.

12. *Ferrocyanide of Potassium.*—Very acid chloride of gallium is precipitated by yellow prussiate. I made the following experiment on a dilute solution of chlorides of zinc and gallium. To this solution I added 4-10ths of its volume of concentrated hydrochloric acid, then a slight excess of prussiate, and, lastly, four times its volume of water (under these conditions cadmium is not precipitated); all the gallium and all the zinc were contained in the deposit, which fact I ascertained by the spectral examination of the filtered liquid. The ferrid-cyanide of zinc and gallium were washed with rather strong hydrochloric acid,

* I suppose, but without having submitted it to experimental verification, that the white precipitate formed by sulphuretted hydrogen in acetate of gallium containing a little zinc is a sulphide and not an oxide.

† Sulphide of zinc is sensibly soluble in hydrosulphate of ammonia. Once having treated chloride of zinc with a large excess of hydrosulphate (yellow), I treated 0·754 grm. of sulphide of zinc with a litre of clear filtered solution; yet this does not define the limits of the solubility of sulphide of zinc.

then decomposed with hydrosulphate of ammonia. The hydrochloric solution of the sulphides gave brilliantly the zinc and gallium spectrum.

(To be continued.)

CONTRIBUTIONS TO VOLUMETRIC ANALYSIS.*

THIRD PAPER.—CORRECTION OF THE ERRORS DUE TO VARIATIONS OF TEMPERATURE.

BY F. CASAMAJOR.

(Continued from p. 152.)

In a paper "On a New Portable Burette," which I had the honour of reading before the Society at the November meeting, I called your attention to the fact that many chemists were unwilling to trust the processes of volumetric analysis, on account of the errors which resulted from the effect of variations of temperature on the strength of the test solutions. These chemists, however, very willingly avail themselves of the reactions of this branch of analysis, and they have adopted the plan of weighing their solutions instead of measuring them. For their use I gave a modification of the portable burette, adapted to being placed on the pan of a balance.

Although it is more accurate to weigh a solution than to measure it, it is difficult to give up the convenience and rapidity which belong to volumetric analysis, and I believe that most chemists prefer to measure their solutions, and many even have adopted the opinion that the errors resulting from variations of temperature are so slight as to be scarcely appreciable.

If we compare this opinion with that of the other chemists before mentioned, that these errors are so important that they are unwilling to trust volumetric analysis, it must strike us that in such an important matter we should have something better than opinions, and that it is desirable to know, with some precision, what degree of change may result from known variations of temperature.

I propose, now, to examine the effect of changes of temperature on the volumes of test solutions, and to give an easy method of correcting the errors resulting from these changes.

At the start I must call your attention to one point, that the reagents used in volumetric analysis are, with few exceptions, in a highly diluted condition, their principal constituent being water, which holds in solution small percentages of acids, alkalies, or salts. A liquid so constituted must expand and contract so nearly like pure water, that any errors which may result from taking for their changes of volume those of pure water must be so small as to be inappreciable.

To determine the changes of volume of water, which correspond to changes of temperature, I propose to make use of the data given by Dr. Matthiessen in his remarkable researches on the expansion of water, glass, and mercury, published in the *Philosophical Transactions* for 1866.† Dr. Matthiessen found that the expansion of water for a rise of 1° C. was different at different temperatures; that it increases as the temperature increases, although the rate of increase diminished. In Table No. I., given below, are to be found, at every five degrees, the fractions of 1 c.c., which represent the expansion of 1 c.c. for a rise of temperature equal to 1° C. The numbers given by Dr. Matthiessen range from 5° to 100° C., but I have not made calculations beyond 45°, which is a higher temperature than is ever attained in our laboratories.

For the researches that we have in view, we need the expansions for a rise of 1°, at every degree centigrade, so as to be able to calculate the total expansion from any degree taken as a normal. The numbers representing these expansions may be obtained by taking a series of

* Read before the American Chemical Society, December 7, 1876.

† See Brooke's "Natural Philosophy," p. 761. London, 1867.

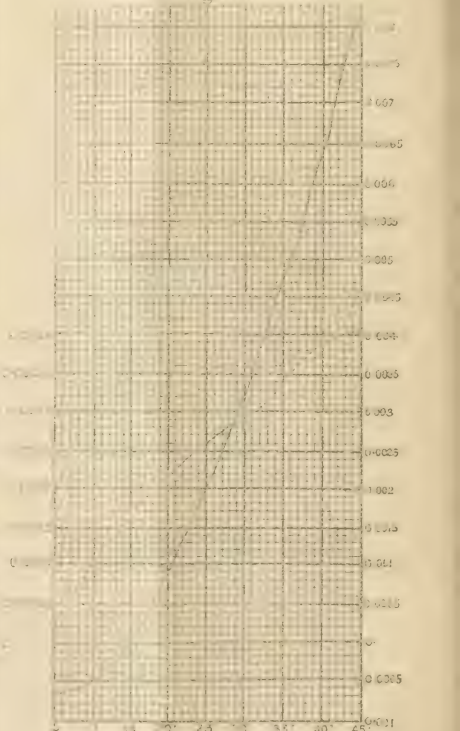
TABLE No. I.

Expansion of 1 c.c. of Water for a Rise of Temperature of 1° C.

At	5° C.	the expansion is	0·000022
,,	10°	,,	0·000098
,,	15	,,	0·000162
,,	20°	,,	0·000215
,,	25°	,,	0·000259
,,	30°	,,	0·000290
,,	35°	,,	0·000345
,,	40°	,,	0·000388
,,	45°	,,	0·000428

perpendicular equidistant lines (see Fig. 1), and adopting, as the abscissæ, the degrees of the centigrade thermometer from 5° to 45°, and, as the ordinates, unities representing 0·00001 of a c.c. The latter numbers are marked on the left in the accompanying figure.

Fig. 1.



By marking on the vertical lines, corresponding to 5°, 10°, 15°, &c., distances from the 0 line representing the expansions for 0° C. at these temperatures, and by connecting these points by a curved line, we are able to find the expansions for every intermediate degree of temperature. This is done by counting on every vertical line the number of divisions from the 0 line to the curve. This

curve is the one drawn with a dotted line in Fig. 1. By drawing this curve with great care on a large scale, the following numbers were obtained for the expansion of 1 c.c. of water for an increase of 1° C. for every degree from 5° to 45°.

TABLE No. II.

Expansion of 1 c.c. of Water at every Degree Centigrade from 5° to 45° for a Rise of 1° C.

Degs. C.	Expansion.	Degs. C.	Expansion.	Degs. C.	Expansion.
5	0·000022	19	0·000205	33	0·000322
6	0·000036	20	0·000215	34	0·000333
7	0·000052	21	0·000224	35	0·000344
8	0·000068	22	0·000233	36	0·000353
9	0·000084	23	0·000242	37	0·000362
10	0·000098	24	0·000250	38	0·000370
11	0·000112	25	0·000259	39	0·000379
12	0·000124	26	0·000266	40	0·000388
13	0·000138	27	0·000272	41	0·000396
14	0·000150	28	0·000278	42	0·000404
15	0·000162	29	0·000284	43	0·000412
16	0·000173	30	0·000290	44	0·000420
17	0·000184	31	0·000300	45	0·000428
18	0·000194	32	0·000312		

The curve which affords the numbers in the preceding table is drawn in Fig. 1 with a dotted line. In the same figure there is another curve drawn with a full black line, which will be noticed hereafter. The dotted curve, which turns its concavity downwards and has quite a regular shape from 5° to 32°, afterwards becomes quite irregular, and, after turning its convexity towards the abscisses from 32° to 40°, becomes concave again with a lesser curvature, which continues pretty regular if the curve is prolonged to 100°. Dr. Matthiessen gave a complicated formula for the volumes from 4° to 32°, and another for those between 32° and 100°.

The figures of the preceding table, which give the expansion of 1 c.c. of water at every degree for a rise of 1° C., will enable us to calculate the total expansion of a volume of water at any temperature starting from any degree as a normal. Although 25° would be a very convenient temperature to take as a normal, as it represents very approximately the average temperature of our laboratories, I propose, in common with the generality of chemists and physicists, to adopt 15° as the temperature from which to calculate the expansions and contractions of our test solutions.

If we take 15° as a normal, we may enquire, What will be the expansion of 1 c.c. of water when the temperature increases to 16°?

In the table given above we find, opposite to 16°, the number 0·000173, which may be taken as the expansion at that temperature. If we wish to know the total expansion from 15° to 17°, we must take the number 0·000184, placed opposite 17° in Table No. II., and add it to 0·000173, which will give 0·000357. In the same manner to find the total expansion from 15° to 18°, we must add to the above number, 0·000357, the number 0·000194, and the sum will be 0·000551. We may proceed in the same manner, from degree to degree, up to 45°, by adding the expansion corresponding to each degree in Table No. II. to the sum of expansions of all the preceding degrees from 16°.

Below 15° we will take for 14° the number 0·000150, placed opposite 14° in the preceding table; for 13°, we will add to 0·000150 the number 0·000138, which will give the total 0·000288; and we may proceed in the same manner, adding the number opposite to each degree to the sum of the numbers corresponding to all the preceding degrees from 14° until we reach 5°. We must bear in mind, however, that for temperatures below 15° C. the numbers represent contractions, and are to be subtracted. The numbers thus obtained will give the second column of Table No. III.

TABLE No. III.

Total Expansions from 15° C.

Degs. C.	Absolute Expansion.	Relative Expansion.
5	0·000878	0·000612
6	0·000856	0·000622
7	0·000820	0·000612
8	0·000772	0·000590
9	0·000706	0·000550
10	0·000622	0·000492
11	0·000524	0·000420
12	0·000412	0·000334
13	0·000288	0·000236
14	0·000150	0·000124
15	Normal	Normal
16	0·000173	0·000147
17	0·000357	0·000305
18	0·000551	0·000473
19	0·000756	0·000652
20	0·000971	0·000841
21	0·001119	0·001039
22	0·001428	0·001246
23	0·001670	0·001462
24	0·001920	0·001686
25	0·002179	0·001919
26	0·002445	0·002159
27	0·002717	0·002405
28	0·002995	0·002657
29	0·003279	0·002913
30	0·003569	0·003179
31	0·003869	0·003453
32	0·004181	0·003739
33	0·004503	0·004035
34	0·004836	0·004342
35	0·005180	0·004660
36	0·005533	0·004987
37	0·005895	0·005323
38	0·006265	0·005667
39	0·006644	0·006040
40	0·007032	0·006382
41	0·007428	0·006752
42	0·007832	0·007130
43	0·008244	0·007516
44	0·008664	0·007910
45	0·009092	0·008312

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

April 14th, 1877.

Professor G. C. Foster, F.R.S., President, in the Chair.

The Secretary described a new form of colorimeter, devised by Dr. Mills. It consists of two vertical glass tubes, about 10 c.m. in length and 2 c.m. in diameter, and contracted at their lower ends, which are graduated in millimetres and fixed in a frame. In each tube a loosely fitting disk of white or black glass (as occasion may require) can be raised or lowered from below by means of a glass rod fitting water-tight, and the meniscus at the surface of the liquid is concealed from view by a hinged screen, so that no confusion arises from a dark meniscus. The two liquids under examination are introduced into the tubes to the same level, and the disks adjusted until rendered invisible when the lengths of the columns are observed. Two solutions, containing respectively 1 part of magenta in 100 and 120 parts of water, were found to be in the ratio of 100 to 119·9.

Mr. Christie gave an account of a new form of spectroscope, in which "half-prisms" are used to magnify

he dispersion. He pointed out that the angle between two pencils is magnified by the action of a half-prism, which, from this point of view, is equivalent to a telescope with cylindrical lenses, the magnifying power being the ratio of the breadth of the incident pencil to that of the emergent. In consequence of this a half-prism will give great dispersion or great purity, according as the rays from the slit fall first on the perpendicular or oblique face, and it may be advantageously used in preference to the ordinary isosceles prism, and adapted to the special circumstances of an experiment. These two positions of the half-prism were distinguished as magnifying and diminishing. Incidentally Mr. Christie explained that the condition of minimum deviation, though essential in Newton's form of spectroscope, was rendered unnecessary by the introduction of the collimator, which makes the rays parallel before falling on the prisms, whilst with a half-prism—which is, of course, not at minimum deviation—there is the great advantage that different parts of the spectrum can be brought into the field by simply turning the prism about its centre, an arrangement which, besides its greater convenience, allows of the use of very large angles, since there is no excessive spreading out of the violet end of the spectrum. The case of a compound prism was then considered, and Mr. Christie mentioned that with a direct-vision half prism a dispersion equivalent to that of ten ordinary prisms had been obtained without any loss of definition. Such prisms can be combined in trains, magnifying or diminishing according as great dispersion or purity is required; and from a comparison with the ordinary long train of prisms there appeared to be a balance of advantages in favour of the half-prisms. From the nature of the case great dispersion must always be accompanied by loss of light, whether by making it necessary to use a narrower slit to get sufficient purity, or by a decrease in the breadth of the pencil utilised, or by absorption in a great thickness of glass, and this increases very rapidly when the thickness of glass is increased; thus 50 per cent of the light is absorbed in passing through 3 or 4 inches of glass, and in a train of ten compound prisms, in which the rays traverse some 28 inches, the absorption was found to be more than 99 per cent. Most spectroscopes would give a much brighter spectrum if they had smaller prisms, but a high magnifying power could not then be applied. In the half-prism spectroscope, though the thickness of glass is far less, yet, as it should not exceed a total of 5 or 6 inches, there would be advantage in using composite prisms exactly similar and cemented side by side. Mr. Hilger has actually made a double prism on this plan which seems to answer perfectly. In illustration of these principles Mr. Christie exhibited three spectroscopes, recently made by Mr. Hilger, in which a wide separation of the sodium lines was obtained by means of two half-prisms (direct-vision), and explained the mechanical arrangement adopted to produce the rotation of the prisms, as well as the way in which an image of the slit is used to form a fiducial line in the field of view. He also showed that by reversing such a train of half-prisms very great purity is obtained, so that the sodium lines are seen in the light of an ordinary unsalted candle without the use of collimating lenses; and he mentioned that he had, in the same way, seen the Fraünhofer lines in the sun and moon.

Dr. HUGGINS called special attention to the convenience and portability of this form of spectroscope, as well as the great advantage of only employing 2 or 3 inches of glass, and he expressed himself as very favourably impressed with the few small instruments he had had an opportunity of examining.

AKADEMIE DER WISSENSCHAFTEN, VIENNA.

January, 1877.

L. BOLTZMANN, "*Notes on some Problems of the Mechanical Theory of Heat.*" The author shows from mathematical considerations that the specific heat of liquids, brought into consideration in the theories with regard to the properties of their saturated vapours, is neither that by constant pressure nor that by constant volume, being slightly greater than these both. The remainder of the communication is devoted to proofs of the mechanical theory of heat based on the principles of analytical mechanics.

C. O. CECH and P. SCHWEBEL, "*On a Peculiar Formation of Iso-cyanphenyl.*" (CHEM. NEWS, vol. xxxv., p. 63.)

February, 1877.

F. LIPPICH, "*On the Theory of Electro-dynamics.*" Taking Neumann's proposed potential expression for the pondero-motory action of two closed, similar, lineal currents on each other as the foundation of electro-dynamics, the author seeks to establish its correctness more directly than has hitherto been done, and bases the theory on the following four grounds:—(1) The principle of the conservation of energy is applicable for the pondero-motory action of any two similar closed currents, fixed or movable; (2) this action is dependent only on the form, intensity, and relative position of the currents: (3) the influence upon each of the two currents is composed of the influences on the individual components; (4) the force exerted by one of the currents on the other is entirely uninfluenced by the presence of other currents.

J. LASCHMIDT, "*On the Thermal Equilibrium of a System of Bodies with reference to Gravitation.*" The author proves that in a vertical column of gas the temperature of the upper strata is less than that of the lower, and then considers the probable effect of gravitation on the thermal equilibrium of the universe. The conclusions arrived at are that the history of the various solar systems consists of a succession of epochs marked in turn by the concentration of matter, evolution of heat, radiation of heat, cooling, renewed increase in the stock of heat, dispersion of the heated masses, and condensation.

F. EXNER, "*Diffusion of Vapours through the Films of Liquids.*" The results of experiments with the vapours of benzine, chloroform, alcohol, carbon bisulphide, and ethyl sulphide show that vapours obey the same law as permanent gases with regard to the diffusion through absorptive films, viz., the velocity of diffusion of different vapours is inversely proportional to the square roots of their densities, and directly proportional to the coefficients of absorption for the respective liquids forming the films.

March, 1877.

A. LIEBEN and G. JANSCEK, "*On Normal Hexyl-alcohol and Normal Œnanthylic Acid.*" Fermentation caproic acid was changed successively into caproic aldehyd, hexyl-alcohol, hexyl-iodide, and œnanthylic acid. The results of the investigation show that normal hexyl-alcohol is identical with the hexyl-alcohol obtained from the essential oil of *Heracleum giganteum*, and that normal œnanthylic acid is identical with the acids obtained from the oxidation of œnanthol, and from the oil of *Heracleum*.

L. LIEBERMANN, "*On Metanitro- and Metamido-benzacetylic Acid.*" The author describes the preparation of these two acids, and shows their structure to be as follows:—

$C_6H_4(NO_2)(CO.CH_2.COOH)$ and $C_6H_4(NH_2)(CO.CH_2.COOH)$,

the latter being isomeric with hippuric acid, but distinguished from it by the double substitution in the benzene skeleton, and by the fact that the substitution does not take place in the amido group.

"*Action of Animal Charcoal on Salts.*" The author finds that the attraction of the charcoal for bases is much stronger than for acids, and that a large variety of salts are decomposed through its action, the acid being released in amounts which could be determined quantitatively. Nearly all chemical compounds are kept back in part by the filtration of their solutions through animal charcoal.

"*Solubility of Sulphur in Acetic Acid.*" All varieties of sulphur are found to be moderately soluble in warm concentrated acetic acid, although almost insoluble in ordinary dilute acids. By cooling or evaporation the sulphur is deposited in the form of long beautiful prisms.

"*Detection of Fuchsin in Wine.*" The strongly marked characteristic absorption-band between yellow and green, yielded by fuchsin solutions, permits of its detection, even in a dilution of 1 : 500,000.

J. v. JONSTORFF, "*Changes in Molecular Form.*" Crystals of iodine, preserved in a glass flask, and exposed for eight years to variations of temperature amounting to 0—24°, increased in diameter from 2·3 m.m. to 4·5 m.m. The change was probably due to volatilisation and subsequent condensation on the larger specimens. Amorphous phosphorus preserved under water and exposed to the same conditions as the iodine, was examined after a lapse of nine years, and found to contain a number of perfectly formed crystals of the ordinary form of phosphorus.

E. v. FLEISCHL, "*Estimation of the Internal Resistance of Galvanic Batteries.*" This is accomplished by joining together the two similar poles of two elements of the battery to be measured, and then comparing the resistance in this combination with a known resistance by means of Wheatstone's bridge.

F. HOFMEISTER, "*On Some Reactions of Amido-Acids.*" The author has examined the conduct of glycin, leucin, sarcosin, asparagin, aspartic acid, glutamic acid, and taurin, with a variety of reagents, and found that with the exception of taurin they yield a number of similar reactions, which can be used as group reactions for their detection.

"*Copper Salts of Tyrosin, Aspartic Acid, and Glutamic Acid.*" The composition and solubilities of these salts are described very fully.

"*Solubility of Copper Oxide in Alkaline Solutions of the Amido Acids.*" Quantitative experiments show that two molecules of glutamic acid, tyrosin, leucin, sarcosin, and glycin, and one molecule of asparagin and aspartic acid, are each able to hold one atom of copper in a state of solution in an alkaline liquid. The solubility is probably dependent on a chemical process and the formation of a double salt.

G. GOLDSCHMIEDT and G. CIAMICIAN, "*A Modification in the Determination of Specific Densities of Vapours.*" The authors determine the volume assumed by the vapours of a weighed substance after passing into the gaseous state by the weight of the displaced mercury. Satisfactory results were obtained with ether, phenol, naphthalin, and resorcin.

F. EXNER, "*Galvanic Expansion.*" The author's experiments show that the elongation experienced by a wire during the passage of a galvanic current is due simply to the heat developed by the current.

J. PULUJ, "*Diffusion of Vapours through Earthenware Plates.*" Experiments with alcohol, ether, and water show that their vapours diffuse through plates of porous earthenware, inversely as the square roots of the densities, with very slight variations of Graham's law. The velocity of diffusion increases with the temperature. The author shows, also, the incorrectness of Dufour's assumption, that dry air diffuses more rapidly than moist air by actual experiment.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

April 9th, 1877.

Prof. C. LIEBERMANN, Vice-President, in the Chair.

PROF. VOGEL stated, in connection with a recent communication of E. Schunck and H. Rœmer, on "*Purpurin*," that his experiments convinced him that light played an important part in the decolouration of an alkaline solution of purpurin when exposed to the oxidising action of the air. Two test-tubes were filled with the solution and placed in the open air by daylight, one being protected, however, by a shield of black paper. In a short time the solution in the unprotected tube was completely decolourised, while the other was entirely unaffected.

A. MICHAEL gives a "*New Method of Preparing Paramido-Benzoic Acid*," preferable to that of oxidation and reduction of para-nitro-toluen, hitherto used on account of the saving in time and substance. Para-tolyl-succinimid, obtained by melting together equal weights of toluidin and succinic acid, is oxidised by a dilute solution of 4 molecules potassium permanganate, and yields oxy-succinyl-paramido-benzoic acid,—

$$C_2H_3(COOH)(CO.NH.C_6H_4.COOH).$$

This acid crystallises in yellow needles, melts at 225°, and gives a series of crystalline salts. By treatment with fuming HCl the insoluble hydrochlorate of paramido-benzoic acid is obtained, and this, upon further treatment with Na_2CO_3 and acidifying with acetic acid, yields paramido-benzoic acid, $C_6H_4(NH_2)(COOH)$. 100 grms. of tolyl-succinimid yield 35 to 40 grms. of the pure acid by this method. An analogous compound, oxyphthalyl-paramido-benzoic acid,—

$$C_6H_4(COOH)(CO.NH.C_6H_4.COOH,$$

insoluble, melting at 275°, was obtained in a similar manner from para-tolyl-phthalimid, and is likewise changed easily into paramido-benzoic acid.

The following communications have been received from non-resident members :—

A. MICHAELIS, "*On the* As *and* P *Derivatives of Benzine.*" By the action of chlorine on diphenyl-arsenchloride, $(C_6H_5)_2AsCl$, several chlorine additive products have been obtained. Phenyl-arsen-chloride, $C_6H_5.AsCl_2$, yields, on treatment with Na_2CO_3, the compound $C_6H_5.AsO$, from which an oxychloride, $C_6H_5.AsCl_2O$, has been prepared, and an acid, $C_6H_5.AsO_2H$. The oxide gives, with bromine, $C_6H_5.AsBr_2$, and a compound, $C_6H_5.AsO_2$, analogous to $C_6H_5NO_2$, has been obtained. The chloride yields, with $(C_2H_5)_2Zn$, $C_6H_5As(C_2H_5)_2$. Higher chlorine derivatives of $(C_6H_5)_2PCl$ have also been obtained. $C_6H_5.PCl_2$, by heating in sealed tubes at a high temperature, is decomposed as follows :—

$$2C_6H_5.PCl_2 = PCl_3 + (C_6H_5)_2PCl.$$

E. ERLENMEYER is of the opinion that the "*Constitution of the Radical* C_3H_5 *in Eugenol*" should be expressed by $-CH_2-CH=CH_2$, and not by $-CH=CH-CH_3$, which he previously advocated.

F. HERRMANN has found among "*The Decomposition Products of Succinyl-Succinic Ether*," in addition to the hydroquinon and hydroquinon-dicarbonic acid previously described by him, also salicylic acid, the formation of which is not easy to explain.

G. GOLDSCHMIDT and G. CIAMICIAN, "*On a New Method of Determining Specific Densities.*" Some slight improvements are made upon the system of determining volumes by the weight of the mercury expelled from the apparatus after the substance enters into the gaseous state—which Victor Meyer first proposed.

P. LAGERMARK has found the "*Action of Sulphuric Acid on Acetylen*" to result in the formation of croton-aldehyd, aldehyd being probably the intermediary product.

O. WITT describes his discovery of the colouring-matter "*Chrysoidin*," lately investigated by A. W. Hofmann (CHEM. NEWS, vol. xxxv., p. 64), and explains his reasons for refraining from publishing the account of it. By treatment with CH_3I and C_6H_5I, he has succeeded in substituting in each case two hydrocarbon groups into the chrysoidin molecule. By a more complicated reaction four methyl groups have been introduced. With sulphuric acid he has obtained a sulphonic acid, $C_{12}H_{12}N_4.SO_3H$. The action of other acids, aqueous vapour, &c., are mentioned, none of the reactions, however, yielding noteworthy results.

W. F. HILDEBRAND and R. FITTIG, "*On the Constitution of Quinic Acid.*" The ethylic ether of quinic acid was exposed for a long time to the action of acetic anhydride, and yielded a fine crystalline substance, ethylic-tetracetyl-quinic acid, $C_6H_7(O.C_2H_3O)_4COOC_2H_5$, melting at 135°, and subliming without suffering decomposition. Quinic acid was further exposed to the action of HBr in sealed tubes at 130°, and was decomposed into benzoic acid and protocatechuic acid, —

$$2C_6H_7(OH)_4COOH = C_6H_5COOH + C_6H_3(OH)_2COOH + 6H_2O,$$

a reaction similar to that taking place with mucic acid. These two reactions show that quinic acid is to be considered as the monobasic, pentatomic acid of hexa-hydro-benzene.

A. BANTLIN finds that by the "*Action of Concentrated HNO_3 on Meta-nitro-phenol*," as well as on the two isomeric dinitro-phenols, styphnic acid (trinitro-resorcin) is produced.

M. TRAUBE, in the course of a study "*On Alcoholic Ferments in Media free from Oxygen*" has obtained results confirmatory of Pasteur's experiments, showing that there are organisms which can exist without oxygen, but refuting Pasteur's opinion that the necessary oxygen is derived from the sugar used in the experiments. Their existence is found to depend on the albuminous nourishment present.

R. FITTIG, "*On the so-called Non-saturated Compounds.*" Oil of camomile yields, by distillation, isobutyric acid, angelic acid, and tiglic acid, the latter two being divided by means of the calcium salt. The additive compounds of these two acids with Br_2 and BrH have also been examined, and in both cases they yield identical bodies, offering a somewhat remarkable case of isomery.

A. LANDOLT and R. FITTIG, "*On the Relations between Fumaric Acid and Maleic Acid, and between Citraconic Acid and Mesaconic Acid.*" The authors have ascertained that each pair of acids yields, with bromine, two distinct derivatives, while the additive compounds formed with hydrogen and hydrogen acids are identical. These facts are, however, consistent with the adoption of the formulæ HOOC.C.CH_2.COOH, and HOOC.CH.CH.COOH for fumaric acid and maleic acid, and corresponding formulæ for the other two.

F. BINDER, "*Additive Derivatives of Cinnamic Acid.*" Two of these compounds yield interesting reactions. Hydrobromo-cinnamic acid and hydriodo-cinnamic acid are changed chiefly into phenylic lactic acid, on boiling with water. Treatment with Na_2CO_3 changes the acids almost completely into styrol,—

$$C_6H_5.CH_2.CHBrCOONa = C_6H_5.CH_2.CH + NaBr + CO_2.$$

O. KRAFFT, by heating terpenylic acid, has obtained a "*Teracrylic Acid*," $C_7H_{12}O_2$, homologous with pyro-terebic acid. It is a colourless liquid, boiling at 216°. In addition to terebic acid and terpenylic acid, the author has obtained another new acid by the oxidation of turpentine oil, which crystallises finely and melts at 163°.

P. GRIESS, "*Researches on Diazo Compounds.*" The author describes the property of diazo bodies of forming peculiar double compounds with tertiary amines. These derivatives are all strong colouring-matters, and differ so entirely from the compounds with primary and secondary amines, in physical and chemical properties, that an entirely different structure is ascribed to them. Azo-benzene-diethyl-amido-benzoic acid is deposited at once in the form of large red crystals, when a solution of diazo-benzene nitrate is poured into a cold solution of meta-diethyl-amido-benzoic acid. It possesses acid properties, and corresponds to the formula—

$$C_6H_5.N.N.C_6H_3(C_2H_5)_2N.COOH.$$

Several analogous compounds, containing substituted methyl groups, sulphonic groups, &c., are described. Theoretical considerations on the constitution of the compounds derived from the union of diazo bodies with primary and secondary amines follow.

P. P. BEDSON finds that, by the action of HNO_3 on para-bromo-phenyl-acetic acid, "*Two Isomeric Bromo-nitro-phenyl-acetic Acids*" result. They are easily separated by means of the varied solubilities of the salts. By oxidation to a known bromo-nitro-benzoic acid, one is shown to be para-bromo-phenyl-acetic acid; the other para-bromo-ortho-nitro-phenyl-acetic acid, is entirely decomposed by oxidising agents.

R. GNEHM and K. FORRER prepare a "*Toluen-disulphonic Acid*" by introducing small portions of toluen gradually into a flask in which solid sulphuric acid is in the melted condition, and then maintaining the temperature at 180° for two hours. It is identical with the α-disulphonic acid obtained by Senhofer in closed tubes, by the action of sulphuric acid and phosphoric acid on toluen.

L. MEDICUS, "*On Glyoxalyl Carbamid.*" The author shows the formula previously proposed for this body to be correct, by the quantitative determination of the decomposition products resulting from the action of KOH, and regards glyoxalyl carbamid as identical with allanturic acid and santanuric acid.

A. ATTERBERG, "*On α-Derivatives of Naphthalen.*" The author communicates some confirmatory proofs to his previous researches in this direction (CHEM. NEWS, vol. xxxiv., p. 270). The two Cl atoms in β-dichloro-naphthalen are shown to be in the same half of the naphthalen molecule by the formation of α-dichloro-phthalic acid, through the action of HNO_3. By the same treatment the two Cl atoms in γ-dichloro-naphthalin are found to be in separate halves of the molecule. The author deduces, from his investigations on the dichloro-naphthalens, additional evidence for the symmetrical form of the naphthalen molecule.

A. CLAUS and G. STEIN have obtained, by the "*Action of Sodium on Epichlorhydrin*," an alcohol, $C_6H_{10}O_2$, forming additive compounds with Br and HCl. The authors find, also, that the small yield of epichlorhydrin, by the treatment of dichlorhydrin with caustic alkalies, is due to the regeneration of glycerin during the process, half of the substance employed undergoing this change.

A. CLAUS and H. POPPE, "*On Mellitic Acid.*" This is easily obtained pure in large quantities, direct from mellite, by digesting the finely-pulverised mineral for several hours with concentrated ammonia. The filtered solution is evaporated to dryness and heated to 130°, at which temperature the humates are decomposed or changed into insoluble forms. The aqueous extract of the residue forms a colourless solution of pure ammonium mellitate, from which the acid is obtained by the usual method with Pb and H_2S. The authors find it impossible, by the action of Zn and C_2H_5I on the ethylic ether, to reduce one of the carboxyl groups to $-C(OH)(C_2H_5)_2$, as is the case with oxalic ether. Oxalic acid appears to stand alone in this respect among dibasic acids. A great similarity is noticed between the hexabasic mellitic acid and the tribasic phosphoric acid. Several acid and double mellitates analogous to the phosphates have been prepared.

A. LADENBURG responds to the recent criticisms of V. Meyer on his researches "*On Ammonium Compounds*" (CHEM. NEWS, vol. xxxv., p. 104), adducing proof to show the purity of his substances and the differences between the isomeric substituted ammonium compounds obtained by him.

University College School.—A large and influential committee has been formed for the purpose of raising a Testimonial to Mr. E. R. Horton, to be presented on the completion of the 11th year of his Vice-Mastership at University College School. A considerable sum has been already received, and it is hoped that the List of Subscribers may be yet largely aumented.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

March, 1877.

The following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine	Sulphuric Hydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Turbid	0·001	0·008	0·195	0·053	22·90	9·180	0·720	0·94	1·740	13·7	4·2
West Middlesex	Turbid	0·001	0·006	0·168	0·073	21·40	9·290	0·500	0·94	1·360	14·3	3·6
Southwark and Vauxhall	Clear	0·001	0·007	0·198	0·071	20·50	9·070	0·430	0·87	2·120	14·3	3·6
Chelsea	Clear	0·000	0·008	0·165	0·054	21·20	8·740	0·460	0·87	1·740	14·3	3·0
Lambeth	Turbid	0·000	0·009	0·186	0·070	22·10	9·010	0·680	0·94	2·060	13·7	4·2
Other Companies.												
Kent	Clear	0·000	0·002	0·375	0·007	30·10	12·040	0·860	1·51	3·360	18·8	4·6
New River	Clear	0·000	0·006	0·168	0·066	21·20	9·240	0·540	0·79	1·330	14·8	4·2
East London	Clear	0·000	0·006	0·150	0·070	22·50	9·408	0·648	0·94	1·900	13·7	4·2

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

Note.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. Meymott Tidy.

CORRESPONDENCE.

OPENINGS FOR YOUNG CHEMISTS IN THE COLONIES.

To the Editor of the Chemical News.

Sir,—If you will kindly allow me space in your next impression I should very much like to ask the opinion of any of your readers as to the likely prospects of getting work for a young analyst in the colonies, more especially in New Zealand or Australia, connected with iron making or other metallurgical undertakings.—I am, &c.,

April 11, 1877.

Colonist.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 14, April 2, 1877.

Experimental Researches on the Natural Sulphides.—M. Stan. Meunier.—Numerous experiments, the results of which were submitted to the Academy, prove that the native sulphides, if brought in contact with metallic solutions, suitably selected, effect the reduction of the dissolved metal. Thus galena, if placed in a solution of auric chloride, is immediately gilded over; in nitrate of silver it is quickly covered with very elegant metallic vegetation, resembling the "Arbor Dianæ;" mercury is also precipitated under the same conditions. The reaction in the first case is expressed by—$3PbS + Au_2Cl_3 = 3PbCl + 2Au + 3S$. In the second case by—$PbS + AgO,NO_5 = PbO,NO_5 + Ag + S$. All the sulphides examined—iron pyrites, copper pyrites, blende, cinnabar, stibene, and even sodium monosulphide (so commonly met with in mineral waters)—give rise to analogous precipitations. Certain selenides, antimonides, arsenides, and tellurides also behave in an analogous manner. The facts point to certain geological consequences, especially as regards the "mineralogical associations" so often remarked in metallic veins. If a vein of galena receives infiltrations of sea-water, always argentiferous, all the silver present will be seized and concentrated by the galena. Native silver is present in certain galenas, and we have thus an explanation of its origin. Further, the free silver, being very finely subdivided, will be exceedingly susceptible of combining with sulphur, which shows us the possible formation of argentiferous galenas. Simultaneously with the reduction of the silver a certain proportion of sulphur is set free. This is found in certain super-sulphuretted galenas, sometimes so rich in sulphur as to burn on contact with a flame. The sulphur liberated will rarely remain long in the free state; often it must combine with the silver.

Theory of Frigorific Machines.—M. A. Terquem.—A mathematical paper, incapable of useful abstraction.

Researches on the Metallic Reflection of Dark and Polarised Heat-rays.—M. Mouton.—This paper, also, is not suitable for abstraction.

Sulphide of Manganese.—MM. P. de Clermont and H. Guiot.—The conversion of the flesh-coloured sulphide of manganese into the green modification has already engaged the attention of several chemists. The authors find that at 305°, in presence of a small quantity of water, the red sulphide is partly converted into the green form. The green sulphide does not, as some have supposed, appear to be an oxysulphide. The authors have not been able to verify the statement of Geuther that the change of colour can be effected by congelation.

Reply to the Remarks of M. E. Chevreul concerning the Phosphorescence of Organic Bodies.—M. Radziszewski.—The author points out that he has examined the subject from a point of view differing from that under which M. Chevreul's researches were conducted.

Bulletin de la Societe Chimique de Paris, No. 4, February 20, 1877.

Products Formed by Calcining the Dregs of Beet-root Molasses in Close Vessels.—M. Camille Vincent.—Already noticed.

Wines Sophisticated with Magenta.—M. S. Cotton.—The author having twice been unable to detect magenta

in wines containing it, points out the necessity of examining the dregs rather than the clear liquid. He filters the wine, and when the filter is drained he places the paper with the deposit in the original bottle, and operates upon it with ether, ammonia, and acetic acid in the usual manner.

Analysis of Pyrogenous Gases.—M. Berthelot.—Already noticed.

Can Ozone Combine with Free Nitrogen in Presence of Alkalies, forming Nitrous Compounds and Nitrates ?—M. Berthelot.—The author has not succeeded in proving the oxidation of free nitrogen by ozone in presence of alkalies.

Memoir on the Ferrocyanides.—M. Wyrouroff (*Ann. de Chim. et de Phys.*, viii., 444 to 486).—In the analysis of these compounds the metal was generally precipitated by an alkali; iron was determined volumetrically by permanganate of potassa. Most of the metallic ferrocyanides have been formed and examined.

Depositing Cobalt upon Metals.—M. R. Bœttger (*Chem. Centralblatt*, vii., 640).—By the use of two Bunsen elements a brilliant deposit of metallic cobalt was obtained upon brass or copper. The salt employed was the double chloride of ammonium and cobalt.

Nickelisation and Cobaltisation of Iron and Steel—M. F. Stolba.—Nickel may be deposited upon iron or steel without the aid of the battery by immersing the objects in a solution of zinc chloride and a salt of nickel, raising to a boil, and bringing the metal to be coated in contact with metallic zinc. A deposit of cobalt may be obtained by an analogous procedure.

Fusion of Nickel and Cobalt.—M. C. Winkler (*Dingler's Journal*, ccxxii., p. 175).—The author has obtained both these metals in ingots of from 2 to 5 kilos. The conditions required are a sufficiently high temperature, the use of refractory crucibles, the absence of carbon and silicon in contact with the melted metal, and protection from atmospheric oxygen during casting.

Use of Nitrite of Soda as an "Antichlore."—M. C. Lieber (*Dingler's Journal*, ccxxi., p. 250).—The author objects to hyposulphite of soda that it leaves finely-divided sulphur among the fibre, which, if not perfectly removed, may become oxidised to sulphuric acid and damage the goods.

Reimann's Färber Zeitung,
No. 15, 1877.

This issue contains nothing of general interest.

MEETINGS FOR THE WEEK.

Monday, April 23rd.—Medical, 8.
—— Royal Geographical, 8.30.
—— Society of Arts, 8. (Cantor Lectures). "The Connection of Greek and Roman Art with the Teaching of the Classics," Sidney Colvin, M.A.

Tuesday, 24th.—Civil Engineers, 8.
—— Royal Institution, 3. "Chemistry of the Heavenly Bodies," Prof. Gladstone.
—— Society of Arts, 8. (African Section). "The Trade and Resources of Morocco," Dr. Arthur Leared.

Wednesday, 25th.—Society of Arts, 8. "Deaf not Dumb," Mr. B. St. John Ackers.
—— Geological, 8.
—— London Institution, 12. (Anniversary).

Thursday, 26th.—Royal, 8.30.
—— Society of Arts, 8. (Chemical Section). "Phosphor-Bronze and its Applications," Mr. Alexander Dick.
—— Royal Institution, 3. "Heat," Prof. Tyndall.
—— Royal Society Club, 6.30.

Friday, 27th.—Royal Institution, 9. "On Arctic Life," Dr. John Rae, M.R.I. (instead of Lieut.-Gen. Strachey, whose Discourse is postponed).
—— Quekett Club, 8.

Saturday, 28th.—Royal Institution, 3. "Babylonian Literature," Rev. A. H. Sayce.
—— Physical

ERRATA.—P. 151, col. 1, line 11 from top, *for* "chromium" *read* "chromic acid." Line 13 from bottom, omit second "10 c.c.," and insert "$K_2Cr_2O_7$."

THE
QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c.

Now ready No. LIV., *April*, 1877, price 5s.

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IV. National Wealth and Public Debt. By F. C. Danvers.
V. "The Great Ice Age" and the Origin of the "Till." By W. Mattieu Williams, F.R.A.S., F.C.S.
VI. The United States Geological and Geographical Survey of the Territories—Explorations in 1876. By F. V. Hayden, Geologist-in-charge.
Notices of Scientific Works, Scientific Notes, &c.

London: 3, Horse-Shoe Court, Ludgate Hill, E.C.

LECTURE NOTES for CHEMICAL STUDENTS. By EDWARD FRANKLAND, D.C.L., F.R.S., Professor of Chemistry in the Royal School of Mines. Second Edition. Vol. I (Inorganic). 4s. Vol. II. (Organic), 5s.

"These 'Notes' will, we believe, be found very useful for students, containing as they do exactly what is wanted, without being overloaded with any superfluous matter, and what is of no less importance in a constantly expanding science like chemistry, bringing up the information to the latest date and in accordance with the most advanced views of English and continental chemists."—*Educational Times.*

JOHN VAN VOORST, 1, Paternoster Row.

TO MANUFACTURERS OF ARTIFICIAL MANURES, DEALERS IN PHOSPHATES, &c.

SUTTON'S HANDBOOK of VOLUMETRIC ANALYSIS (new edition, largely illustrated, 8vo., 150 pp.) contains all the newest information on the rapid analysis of Superphosphates and all other Phosphatic Manures with great accuracy. By instructions there given it is possible for intelligent foremen and others who are not expert chemists, to ascertain in a few minutes the percentage of soluble and insoluble phosphates of whatever kind in any manure.

All the necessary apparatus and materials can be had of Francis Sutton and Co., Norwich.

"The Handbook of Volumetric Analysis" is published by J. and A. CHURCHILL, New Burlington Street, London.

Ready, pp. iv. and 73, price 2s. post free.

The Analysts' Annual Note-Book for 1875.
Edited by SIDNEY W. RICH. Contains the principal part of the Analytical matter of the year in a partially condensed form.

To be obtained through the post only of S. W. RICH, 23, Lloyd Square, London, W.C.

SALE of MANUFACTORIES from the Bankruptcy Estate of the Joint Stock Company for Chemical Industry at Papenburg (Germany). These manufactories, which are in communication through navigable canals with the Westphalian Railway and with Ems, viz., the North Sea, will be sold, separately or in totality, by PUBLIC AUCTION. They consist of:—

I. SUBSTANTIAL OIL MILLS, established on approved system, producing 120 cwts. daily; the plant comprises a Corliss engine of 24-horse power, one hydraulic front and two aft presses with pump-work, four couples of stamping presses, breakers, three couples of grinding stones, &c., iron tanks for 900 cwts. oil; extensive warehouse, three storeys high, and storehouse for 10,000 cwts. of seed.

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III. MANUFACTORY of CHEMICALS, erected 1874, according to the latest improvements, consisting in substantial well-burnt dwelling-house, laboratory, storehouses, &c. (*a*) The sulphuric acid factory, producing daily 30 cwts. of stones, with a Gay-Lussac, concentration pans, air and steam pumps, three rollers, nitric acid apparatus, &c.; (*b*) The sulphates factory, daily 30 cwts., with superior condensation of the salt acids; (*c*) The glue and bone products factory, with steam engines of 3- to 12-horse power, iron "kollergang," stamping mill, copper boilers, vacuum, drying rooms with folding apparatus and ventilator. The artificial manure has acquired a great renown. Bones can be obtained from the neighbourhood in sufficient quantity and fuel in any amount from the inexhaustible turf-pit adjoining the manufactory.

The public sale of above will take placed within six to eight weeks time.—For further particulars apply to Obergerichtsanwalt, Dr. Finkenburg, at Weener (Ostfriesland), Germany.

THE CHEMICAL NEWS.

Vol. XXXV. No. 909.

ON THE NEW METAL—GALLIUM.*

By M. LECOQ DE BOISBAUDRAN.

(Concluded from p. 155.)

VI. Salts of Gallium.

The 10 centigrms. of pure gallium obtained at the end of April, 1876, were almost immediately sacrificed in trying to determine the equivalent, for which, moreover, I have not yet found numbers sufficiently concordant. It has, therefore, been impossible for me at present to utilise, in the preparation of its compounds, those relatively large quantities of gallium which I have obtained. I have only employed for this purpose the few milligrms. of the new metal produced from the earliest operations,† so I shall only describe, and that very summarily, a small number of gallium salts. All the compounds of gallium which I have examined are colourless.

1. *Chloride.*—Chloride of gallium is very soluble in water, and deliquescent. If its solution is evaporated and carefully dried, the residue attracts moisture from the air and liquefies. The syrupy solution thus obtained is clear, and does not become turbid if diluted with a *very small* quantity of cold water. A larger quantity of water, however, causes the formation of a copious white precipitate (doubtless an oxychloride) which falls quickly to the bottom of the vessel, and which dissolves only slowly in dilute hydrochloric acid in the cold, but more rapidly by the aid of heat. In researches on gallium this property must be borne in mind, otherwise there is a risk of the rare metal being left in the residues precipitated in the cold by weak hydrochloric acid. In order to extract all the gallium from an insoluble product the latter must be boiled with water strongly acidulated with hydrochloric acid. In my earlier researches I often failed to detect the presence of the new metal in consequence of the great difficulty in separating it from the masses of insoluble residues with which it had become incorporated. If a *very small* quantity of hydrochloric acid is added to some dried chloride of gallium the latter is dissolved in cold water; this dilute solution becomes turbid when hot, and grows clear again on cooling. If a slightly acid solution of chloride of gallium is dried at a gentle heat it yields crystalline needles and leaflets, which act strongly upon polarised light.

2. *Sulphate.*—This salt is very soluble in water. The concentrated solution is syrupy. It is not deliquescent. When very neutral it decomposes on boiling; very little gallium remains in the liquid provided the latter is sufficiently dilute. When cold the precipitate is completely re-dissolved. Sulphate of gallium is soluble in alcohol at 60 per cent. It is insoluble in ether. By slow evaporation, or on the cooling of a concentrated solution, it crystallises in the form of leaflets, soft to the touch, having a pearly appearance, and being sometimes grouped in stars or shining masses. If evaporated and dried until the evolution of white sulphuric vapours almost ceases, an acid sulphate of gallium does not lose its solubility in water nor in weak alcohol; a certain time is, however, required for the completion of the solution.

3. *Alum.*—I have obtained a well crystallised salt, which to all appearance is ammonio-gallic alum. The quantity at my disposal has not been sufficient to enable me to analyse it nor to measure its angles, but its characteristics are sufficiently distinct for its nature to be determined. This salt has been prepared by neutralising with ammonia an acid solution of sulphate of gallium, and allowing the liquid to evaporate slowly. There could not be in it any other alkalies than ammonia and traces of soda. The alumina ought to have been separated by repeated treatments with sulphuretted hydrogen in the presence of acid acetate of ammonia and salts of zinc.

The following facts relate to the small crystals presented to the Academie des Sciences on December 6, 1875:—

Gallium alum is colourless and limpid. It is soluble in cold water and in weak alcohol. A concentrated solution becomes slightly turbid on boiling, and clears completely on cooling. When the solution is very dilute the boiling causes the formation of an abundant white precipitate; this is probably a basic salt. If filtered when hot only traces of gallium remain in the liquid. The precipitate may then be washed over the filter at first with boiling, then with cold water, without sensible loss of gallium, but if it is left in contact with the mother-liquor it is completely re-dissolved when cooling. The dilute solution of gallium alum does not become turbid on boiling if a little sulphuric acid is added. A certain quantity of acetic acid produces the same effect; doubtless an equilibrium is then maintained between the acetate and the sulphate of ammonia, and the small portion of sulphuric acid set at liberty holds the sulphate of gallium in solution. Unlike acid acetate of ammonia, gallium alum behaves itself with heat and in the cold exactly like the neutral sulphate.

Gallium alum crystallises into cubes having octahedric faces, and into octahedra with cubic faces. These crystals present exactly the aspect of common alum; their solution, if slowly evaporated, behaves under the microscope just like the known alums. Placed between two Nicol prisms gallium alum does not act upon polarised light. With respect to the phenomena of supersaturation gallium alum behaves as a veritable isomorph of the other alums.

A small crystal was kept for some time under a layer of water, in order to deprive it of the crystalline germs attached to its surface. It was afterwards laid in a slightly supersaturated solution of alumino-ammoniacal alum. It grew immediately therein, and determined the crystallisation of the liquid.

I have recently proved that gallium alum is produced when solutions of sulphates of ammonia and pure gallium are mixed. If protected from atmospheric dust the liquid remains clear, but it crystallises as soon as it comes in contact with a trace of common alum. A supersaturated solution is equally well obtained if slightly acid gallium alum is concentrated in the heat. If, as seems certain, there is no error in the nature of my gallium alum and ammonia, the existence of this combination fixes the atomicity of the new element, and attributes to its oxide the same chemical function as that of alumina. The oxide of gallium will, then, be described as Ga_2O_3, and the chloride probably Ga_2Cl_6. Besides, all the properties above described agree in classifying the oxide of gallium among the sesqui-oxides. Up to the present time I have observed nothing which indicates several degrees of oxidation of gallium.

VII. Extraction and Purification of Gallium.

As soon as the principal chemical characteristics of the new element were known to me, I tried to discover the most economical and rapid method of extracting and purifying it.

The following is the method I adopted for the treatment of several hundred kilogrammes of raw material:—The crude blende, reduced to powder, is dissolved by the aid of heat in *aqua regia*, containing 4 or 5 parts of hydrochloric acid to 1 of nitric acid.† After cooling the undissolved residues of blende are alternately added, so as not to leave any nitric acid in the final liquid, whilst the ore is completely attacked.

* Communicated by the Author.

† It is quite recently that I have obtained the 65 centigrms. mentioned on page 156.

‡ In working with ores rich in arsenical calamines, hydrochloric acid will be sufficient.

In the filtered acid solution pieces of sheet-zinc are placed. A metallic sponge is deposited (Cu, As, Pb, Cd, In, Tl, Hg, Se, Ag, Bi, Sn, Sb, Au, &c.). The solution is filtered when the escape of hydrogen has greatly subsided, though yet perceptible. The liquid which contains the gallium is poured into receivers (or into carboys placed over a water-bath). A large excess of zinc is then added to it, and it is heated for six, twelve, or twenty-four hours, according to the temperatures attained. A gelatinous precipitate (not adhering to the sheets of zinc) is formed. This is collected on filters, and is found to contain alumina, sub-salts of zinc, often silica, cobalt, chromium, &c., and also a little of the metals reducible with zinc and gallium.

In order to ascertain that the boiling has been sufficiently prolonged, a sample of the liquor is filtered, and one-fifth of its volume of water is added; spring- or river-water is very suitable for this purpose, on account of the calcareous bicarbonate which it ordinarily contains. If the liquid becomes notably turbid the boiling is sufficient. From one-fourth to one-third of its volume of the same common water is then added before the liquid is transferred to the filters.

Unless the ore is very rich the hydrochloric solution of this first precipitate does not give the gallium rays in the spectroscope. However that may be, the deposit, well washed, is re-dissolved in hydrochloric acid, and the new liquid treated with zinc exactly in the same manner as the first solution was with aqua regia. Although the ore may be very poor, the second gelatinous precipitate will give the gallium rays.

The treatment with metallic zinc may now end, but time is gained, without any sensible loss of gallium, by repeating the operation a third time. It is, however, useless to push any further the elimination of the zinc.

The last gelatinous precipitate is dissolved with hydrochloric acid; it is evaporated to expel the great excess of acid, a small portion of which must, however, remain free. The liquor is diluted with distilled water, and a current of sulphuretted hydrogen is passed into it. It is filtered, acetate of ammonia and acetic acid are added, and it is then gain treated with sulphuretted hydrogen.

If there is much zinc and very little gallium, the latter is carried down effectually with sulphide of zinc. The spectroscope indicates whether any gallium remains in the last fractions of sulphide of zinc.

If the ray Gaα 417·0 is still visible in the spectrum of the hydrochloric solution of the last sulphide, a neutral salt of zinc is added, and the treatment with sulphuretted hydrogen and acid acetate of ammonia is renewed. It ends by insignificant traces only of gallium remaining in the liquid.

It is well not to continue the treatment with sulphuretted hydrogen after all the zinc has been precipitated, so as to avoid the formation of sulphide of cobalt, which would contaminate the product.

The sulphides are carefully washed with a dilute solution of acetate of ammonia, charged with sulphuretted hydrogen, and to which a little acid acetate is added; they are afterwards dissolved in hydrochloric acid, and the treatment with sulphuretted hydrogen and acid acetate of ammonia is repeated.

The hydrochloric solution of the sulphides (deprived of sulphuretted hydrogen by boiling and by the addition of a few drops of nitric acid) is precipitated with carbonate of soda in the cold,* care being taken to fractionate the products.

The gallium is rapidly concentrated in the first deposits, and its total disappearance is rather sudden, as indicated by the spectral reaction. I shall designate the hydrochloric solution of the first precipitates formed by carbonate of soda as *impure chloride of gallium*. Hitherto our aim has been to unite in a small volume all the gallium contained in the ore.

In the preparation of pure metallic gallium the principal point to be aimed at is the removal of all foreign bodies, even at the risk of carrying off at the same time a small portion of gallium, which, however, is afterwards worked up.

The *impure chloride of gallium* is treated in the cold with sheets of zinc; the contact must be continued till the liquor begins to be rendered turbid by sulphuretted hydrogen. The greater part of the indium, thallium, cadmium, and lead, as well as sensible traces of gallium, are then precipitated on the zinc plates and are separated by filtration.

A current of sulphuretted hydrogen is passed into the liquid. A little sulphide of zinc is separated, carrying away with it the remaining portions of the indium, cadmium, and lead, and also a small quantity of gallium. The solution is filtered, acetate of ammonia with excess of acetic acid is added, and it is treated with sulphuretted hydrogen, &c., as before mentioned. If necessary, a neutral salt of pure zinc is added.

In the hydrochloric solution of the sulphides gallium is precipitated fractionally with carbonate of soda. The deposits found by the spectroscope to be poor in gallium are thrown on one side. By repeating this operation a second time the whole of the zinc and cobalt is separated. Towards the end of the treatment sulphuric and not hydrochloric acid must be employed, as the presence of the latter would be injurious during the electrolysis.

The purification is completed by treating once or twice with ammonia in excess. A *great deal* of gallium remains in the ammoniacal liquid; this is not added to the other gallium products, but is treated separately. It is better to let it boil till the free ammonia is almost entirely expelled. The gallium is deposited together with zinc and other metals; this deposit is re-dissolved with sulphuric acid, and treated afresh with ammonia. In this way an important supply of oxide of gallium purified with ammonia is obtained. A second operation likewise furnishes a weaker supply of the same oxide.

The liquids charged with ammoniacal salts are united and boiled with aqua regia; the residue, tolerably rich in gallium, re-enters into the operation.

The pure oxide of gallium* is dissolved in caustic potassa. The electrolysed solution causes the gallium to be deposited in a liquid state† on the sheet of platinum,‡ serving for the negative pole.

The surface of the positive electrode (platinum) should be 2, 4, 6, or 10 times larger than that of the negative electrode. The ratio of the polar surfaces is regulated according to the power of the battery and the concentration of the liquid. To electrolyse 20 or 30 c.c. of solution five or six Bunsen elements are sufficient. Even with a stronger battery it takes a long time to extract by means of electrolysis all the gallium contained in the liquid.

Electrolytic gallium covers the negative electrode with an adhesive layer, which may, however, be detached when it has acquired a notable thickness, by bending the sheet of platinum in cold water, after the gallium has solidified. The gallium is isolated more easily still by pressing the sheet of platinum between the fingers in warm water.

I have recently simplified and greatly shortened the process of extracting pure gallium by working as follows:—

1. The ore, according to its nature, is dissolved in aqua

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* The decomposition of neutral salts of gallium when boiled renders difficult the fractionating by carbonate of soda whilst hot, for the precipitates are partly re-dissolved while cooling.

* The great heat must also help to contribute to the separation of the last traces of aluminium from the gallium, for I have ascertained with certainty that the electrolysis of a solution of alumino-ammoniacal alum in caustic potassa does not lead to the reduction of metallic aluminium on the negative electrode under the conditions by which gallium is readily isolated. If any traces of aluminium were reduced at the same time with the gallium, it could only be by an [illegible], which, moreover, has not yet been brought under my notice.

† The passage of the voltaic current heats the solution so strongly that the vessel has to be surrounded with cold water.

‡ I have tried to reduce the gallium on a plumbago electrode, but that substance, being porous, absorbed the liquid metal.

regia, hydrochloric, or sulphuric acid. The liquid is treated with zinc and heated; this operation is repeated a second time, as before stated. A current of sulphuretted hydrogen is passed into the hydrochloric solution of the second precipitate formed by the zinc; it is filtered, and the sulphuretted hydrogen is driven off. It is fractionated with carbonate of soda, ceasing when the ray $Ga\alpha$ 417·0 ceases to be visible in the hydrochloric solution of the precipitate.

3. The oxides (or sub-salts) are taken up with sulphuric acid; the solution is carefully evaporated until white sulphuric acid vapours are no longer, or but slightly, given off. It is allowed to cool, and is then stirred with water, which dissolves the mass after the lapse of a time varying from a few hours to a couple of days. If there are any portions rendered insoluble by too strong calcination, they are treated with sulphuric acid and evaporated again to dryness. The solution of the sulphate, almost neutral, is diluted with a great deal of water and boiled. The sub-salt of gallium is separated by filtration *when hot*. If the evaporation to dryness has not been carried far enough to drive off nearly all the free sulphuric acid, little or no deposit will be formed during the boiling of the dilute solution of the sulphate. In this case the evaporation must be repeated and the desiccation pushed a little further.

4. The sub-salt precipitated by boiling is dissolved in a little sulphuric acid, and a slight excess of caustic potassa is added, so as to re-dissolve the gallium but to leave the iron. A prolonged current of carbonic acid gas precipitates the oxide of gallium.

5. This oxide is re-dissolved with a minimum of sulphuric acid; an excess of slightly acid acetate of ammonia is added,* and then sulphuretted hydrogen is passed into it.

6. The acetic liquor is diluted with water and boiled. The greater part of the gallium is precipitated. It is filtered whilst hot and washed with boiling water. The mother-liquor, concentrated, and boiled with aqua regia in order to destroy ammoniacal salts, is added to the other gallium residues.

7. The precipitate formed on heating the acetic acid is re-dissolved in sulphuric acid; a slight excess of caustic potassa is added, and it is filtered.

8. The potassic solution is then electrolysed.

The different residues proceeding from these manipulations can be added to the first gelatinous precipitates formed by the zinc (operation No. 1). It is better, however, to treat them separately: first, by fractionation with carbonate of soda to separate the greater part of the zinc, cobalt, &c., then by caustic potassa to carry down the iron. The product is then added to that resulting from operation No. 2.

If a residue is obtained containing little gallium and much iron, the most simple method is to treat with zinc by the aid of heat, protecting it from the air; the greater part of the iron will remain in solution.

A residue very rich in alumina and very poor in gallium would be treated either by ammonia in excess, taking care to repeat the operation, or by sulphuretted hydrogen, in presence of acetate of ammonia and a zinc salt.

The gallium obtained by the above-described methods seems to be very pure. It may, however, still contain minute traces of foreign metals, especially of iron. It may be brought to a great state of purity by immersing it for about half an hour at a temperature of from 60° to 70° in nitric acid (*very free from chlorine*) diluted with its own volume of water. The melted metal is washed and the globules are easily united under warm water. The loss of gallium is not very considerable.

VIII. Relative Richness of Gallium Ores.

It may be very useful to those chemists who wish to prepare gallium if I give here some indications of the relative richness of the raw materials that I have examined.

In the following list the substances are arranged according to their richness in gallium, beginning with the richest.

Rich Substances.

1. *Black Blende from Bensberg (Rhin Prussien)* sent by the Vieille-Montagne Mining Company (mines: Apfel, and Lüdrich, Galerie Frazisca). This is the richest ore I have yet met with. The blende from the mine Lüdrich seems to me rather superior to that of Apfel.

2. *Yellow Transparent Blende from Asturias.*—Seems to be of intermediate richness between the blendes of Bensberg and of Pierrefitte. It contains sensible quantities of mercury.

3. *Brown Blende from Pierrefitte.*—(Vallée d'Argelis). Notably less rich than the Bensberg blende, but considerably more so than the following substances:—

Rather Poor Substances.

4. *Zinc in Powder and in Grains (Tutty).*—Bought at Cognac at a house-painter's, and coming from the mines of the Vieille Montagne. Contains very sensible traces of gallium.

5. *Cadmies from Corphalie.*—Contain sensible traces of gallium. The portion of these sublimates which is not acted upon by hydrochloric acid yields with boiling sulphuric acid traces of gallium much less weaker than those which are first removed by hydrochloric acid.

Very Poor Substances.

6. *Zinc Dross* (a mixture of metallic zinc and oxide of zinc).—Used for the manufacture of sulphate of zinc in the Javel Works (Paris). Contains traces of gallium.

7. *Yellow Blende, slightly Brownish, Opaque,* from Mandesse (Gard).*—Shows rather feeble traces of gallium.

8. *Brown Blende from Sweden* (sent by the Vieille Montagne Mining Company).—Gives feeble traces of gallium.

9. *Black-brown Blende from Schwarzenberg (Saxony).*—Rich in indium, but containing only feeble traces of gallium.

10. *Blende in Rods from Nouvelle-Montagne* with calcareous gangue. Has furnished very weak traces of gallium.

Substances Giving no Appreciable Trace of Gallium.

Ribbon-blende from the Vieille-Montagne.
Galenas from Pierrefitte and elsewhere.
Tutty of Corphalie.
Laminated Zinc coming from the works of Vieille Montagne, and used at Cognac for building purposes.
Carbonated Calamines from Sardinia.—Two samples.
Carbonated Calamines from Le Gard.—Two samples.
Hydrochloric Acid of commerce.
Nitric Acid of commerce.

IX.

I cannot bring this memoir to a close without referring to the very interesting note which was published on the 22nd November, 1875, in the *Comptes Rendus* by M. Mendeleef relating to the classification of elementary bodies, to the prevision of unknown elements, and to the calculation of their probable properties.

Amongst the numerous hypothetical bodies whose existence is indicated by M. Mendeleef's ingenious classification there is one which, taking its calculated properties as a whole, seems to correspond to gallium, from which it differs, however, in some respects.

As frequently happens when two persons are occupied independently with analogous researches, the theories of the learned Russian physicist agree with mine on certain points, whilst they differ in others. At a future time I hope

* The sulphuric liquid should not be too acid, and care must be taken not to add too large a quantity of acid acetate of ammonia, or a notable part of the gallium will be left in the boiling acetic solution.

* Containing the geode covered with little yellow transparent crystals.

In return to M. Wurtz [illegible] own [illegible] [illegible] that [illegible] I think it right to comment that the [illegible] between the spectra of [illegible] and indium, and indicated at the time of my [illegible] observations of the [illegible] and Ga [illegible].

I immediately calculated the [illegible] of the new metal by combining the application of my spectral laws (see *Comptes Rendus*, January 24, 1876, page 170, and March 2, 1876, page 677), with my theoretical ideas on the classification of the elements.

These remarks were communicated to M. Wurtz and other *savants*; but owing to the difficulty of clearly establishing the reactions and chemical functions of gallium with such rare and impure material as I at that time possessed, I thought it prudent to simply announce the *facts* which I had observed, reserving till a later period an exposition of my theoretical considerations.

I ought also to say that I was ignorant of the description given by M. Mendeleef of the properties of his hypothetical metal. I will even add that this ignorance may perhaps have been advantageous to me, for I should have experienced serious delays if I had been led to seek for gallium in the precipitates formed by ammonia, and not in the ammoniacal solutions in which it is entirely, or almost entirely, contained when it is in feeble quantity.

In fact, the properties of M. Mendeleef's hypothetical metal should "present the mean between those of aluminium and of indium." Now oxide of indium is considered to be almost insoluble in ammonia, a property which is utilised in its separation. As for alumina, its solubility in ammonia, though slight in presence of ammoniacal salts, is sensible.

As long as I possessed only a few milligrms. of impure compounds of gallium I admitted that the great delicacy of the spectral reactions and the extreme minuteness of the quantities upon which I operated might have caused me to over-estimate the relative solubility of oxide of gallium in ammonia to that of alumina; but more recent experiments have confirmed my first observations, in which I attributed to oxide of gallium a turbidity in ammonia greater than that of alumina.

We have seen (page 159) that on fractionated precipitation with carbonate of soda oxide of gallium seems to be precipitated before the alumina, and is certainly deposited before the oxide of indium. According to theoretical previsions the precipitation of oxide of gallium should be intermediate between the oxides of indium and alumina. It seems equally difficult to reconcile the extreme fusibility of gallium with the results obtained by theoretical calculations.

It will thus be seen that, notwithstanding the incontestable merit of M. Mendeleef's hypotheses, many reactions and qualities of the new metal differ sufficiently from those indicated by theory to have rendered the success of a research very problematical if it had been guided solely by that theory, and the ore employed had been very poor in gallium.

It seems to me probable, then, that without the particular experimental method which I followed neither M. Mendeleef's calculations nor my own hypothesis would for a long time have led to the discovery of gallium.

However, the discovery of the new metal gives to the classifications predicting the existence of unknown elements an importance which it was impossible, I think, to accord to them until they had been verified by some positive fact. I need not insist on the extreme interest which is particularly attached to the confirmation of M. Mendeleef's views concerning the density of gallium.

Now it is known that in mineral chemistry (as well as in organic chemistry) the natural classifications approach sufficiently near to the truth for the theoretical data derived from them to be afterwards utilised in science. A too absolute signification ought not always to be attributed to these hypotheses; but they should be employed as indications, a little vague perhaps, though *as a whole* sufficiently correct to form a reasonable basis for researches, especially for the institution of new experimental methods, the application of which rarely fails in leading to interest-[illegible] *Comptes Rendus*.

CONTRIBUTIONS TO VOLUMETRIC ANALYSIS.

Third Paper.—Corrections for the Errors Due to Variations of Temperature.

By P. Casamajor.

Read before the American Chemical Society, December 7, 1876.

In the preceding remarks we have, with a view of presenting the subject in its greatest simplicity, purposely omitted an element, which must now be taken in consideration. We have spoken of expansions, but have not specified whether they were absolute or relative to the expansion of glass. We may now say that the expansions we have given are the absolute expansions of water. As our object, however, is to discover the changes of volume due to variations of temperature as they occur in glass burettes, it is not the absolute expansion we need, but the relative expansion with regard to glass.

If a liquid is placed in a glass vessel, and the temperature increases or diminishes, if both the glass vessel and its contents remain at the same temperature, everything will take place exactly as if the dimensions of the glass vessel did not vary, and the expansion of the liquid was the difference between the expansion of the liquid and the expansion of glass. Now, the cubic expansion of glass is 0·000026, and it remains the same for all temperatures. Therefore, to obtain the total relative expansion of water at any temperature, starting from 15° as a normal, we must subtract from the total absolute expansion of water at that temperature, as given in the second column of Table No. III., as many times 0·000026 as the number representing the temperature is removed from 15°. At 16°, the relative expansion is then 0·000173 − 0·000026 = 0·000147; at 17°, the total relative expansion will be [illegible] 0·000537 − 0·000078 = 0·000459, &c.

The numbers obtained in this way can be placed opposite to the numbers representing the corresponding total absolute expansions, and they will form the third column of Table No. III. By means of the numbers in this third column we may easily calculate the volume of liquid at 15° corresponding to any volume observed at any temperature. If we have used 35 c.c. of test solution at a temperature of 37° C., we will find the corresponding volume at 15° by noting that the total relative expansion from 15° to 37° is 0·005323, which means that 1 c.c. of water, in passing from 15° to 37°, becomes 1·005323 c.c.; therefore by dividing 35 c.c. by 1·005323, the quotient, 34·819 c.c., represents the volume at 15°, corresponding to 35 c.c. at 37°.

Instead of dividing 35 by 1·005323 the operation would be much simplified by multiplying by—

$$\frac{1}{1{\cdot}005323} = 0{\cdot}994\,7\,{}^{+}5,$$

and a table might be formed in which, opposite to each degree of temperature, would be found a factor, by which to multiply the volume of test liquor used in an analysis.

I have, however, to propose a plan which is easier and more simple in practice, and which will be readily understood by referring to the curve drawn with a full black line in Fig. 1. If we suppose, as before, that the space between two vertical lines represents 1° C., and if we attribute to the space between two horizontal lines a value equal to 0·0001 c.c., as shown on the right of Fig. 1, we may mark on every vertical line, starting from the horizontal line marked 0, a distance equal to the number 0·0001 c.c., which represents the total relative expansions at the corresponding temperature. We may now connect all the points thus obtained by a curve. This, by referring

to Fig. 1, is the curve drawn with a full black line, which presents the appearance of an imperfect parabola with its apex at 6° C.* By referring to Fig. 1, we may notice that this curve intersects the horizontal lines corresponding to 0·0005, 0·001, 0·0015, 0·002, 0·0025, &c., at certain points, and that we may easily ascertain to what temperatures these points correspond. We will then find that—

−0·0005	corresponds	to	9·9° C.
0·000	,,	,,	15·0 ,,
0·0005	,,	,,	18·2 ,,
0·001	,,	,,	20·75 ,,
0·0015	,,	,,	23·2 ,,
0·002	,,	,,	25·3 ,,
0·0025	,,	,,	27·3 ,,
0·003	,,	,,	29·1 ,,
0·0035	,,	,,	31·2 ,,
0·004	,,	,,	32·8 ,,
0·0045	,,	,,	34·5 ,,
0·005	,,	,,	36·1 ,,
0·0055	,,	,,	37·6 ,,
0·006	,,	,,	38·8 ,,
0·0065	,,	,,	40·4 ,,
0·007	,,	,,	41·6 ,,
0·0075	,,	,,	42·9 ,,
0·008	,,	,,	44·2 ,,
0·0083	,,	,,	45·0 ,,

Now if we take a centigrade thermometer, ranging from 5° to 45°, and on one side of the column we mark the degrees of temperature, we may, on the other side, mark the places where 1 c.c. becomes 1·0005, 1·000, 0·0015, 1·002, &c. If we have made a volumetric analysis and used a certain volume of test solution at a known temperature, we will find, on the right of the thermometer, the number by which we must divide the volume of test solution to have its corresponding volume at 15°. If we have used 63 c.c. at a temperature of 35° C. we may note that the expansion marked on the scale on the right of the thermometer, which comes nearest to the required expansion is 1·0045, which corresponds to 34½°; and on dividing 63 by 1·0045 we will obtain 62·7 c.c.

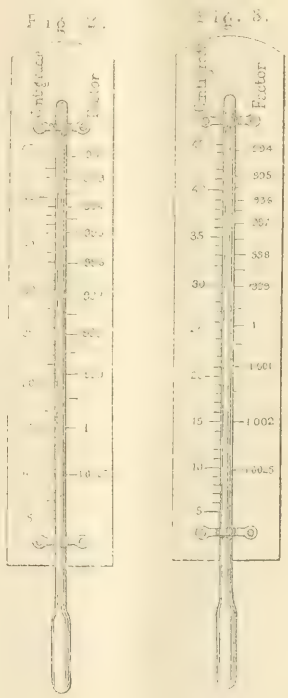
Instead of dividing by the numbers which represent the expansions at various temperatures, we may, as before, multiply by a number representing unity divided by these expansions. We may mark these numbers on the thermometer as follows :—

At	9·9°	Centigrade 1·0005
,,	15·0	,, 1·000
,,	18·2	,, 0·9995
,,	20·75	,, 0·999
,,	23·2	,, 0·9985
,,	25·3	,, 0·998
,,	27·3	,, 0·9975
,,	29·4	,, 0·997
,,	31·2	,, 0·9965
,,	32·8	,, 0·996
,,	34·5	,, 0·9955
,,	36·1	,, 0·995
,,	37·6	,, 0·9945
,,	38·8	,, 0·994
,,	40·4	,, 0·9935
,,	41·6	,, 0·993
,,	42·9	,, 0·9925
,,	44·2	,, 0·992

In Fig. 2, I give a thermometer marked in this way. On the left are the degrees C., while on the right are the numbers by which we must multiply the reading of the burette to reduce them to the corresponding volumes at 15° C. If we have used 85 c.c. of a solution, and if the temperature is 32½° C. we will find that the nearest factor is 0·996, which corresponds to 32·8°. If we multiply 85 by 0·996 the product, 84·66 c.c., is the correct reading at 15°.

To be able to make use of the corrections afforded by the methods given above, it is necessary, in the first place, that our test-solutions should all be titrated at 15°. This can be easily done by using the data already given. Suppose we have weighed 6·3 grms. of pure dry crystallised oxalic acid and dissolved the whole quantity in water, this quantity of oxalic acid represents 100 c.c. of a titrated solution of oxalic acid containing 63 grms. to the litre. These 6·3 grms. of acid are capable of saturating exactly 100 c.c. of titrated solution of potassic hydrate, containing 56 grms. to the litre. If we have a solution of potassic hydrate of unknown strength, and we wish to discover the volume of it at 15°, which will be equivalent to 100 of the solution containing 56 grms. to the litre, we will proceed as follows :—

If we have used 110 c.c. of the potassa solution to saturate 6·3 grms. of oxalic acid, and if the temperature is 34° C., we may, by consulting the thermometer o Fig. 1, find that 0·9965 is the nearest factor on the scale, and if we multiply 110 by 0·9965, the product, 109·65 c.c., will give the volume at 15° C.



Although, in accordance with nearly universal usage, I have adopted 15° C. as the normal temperature, I have pointed out that 25° is nearer the average temperature of our laboratories. To those wishing to adopt 25°, or any other temperature, as a standard, the table marked No. 2 will afford all the necessary data. If they should desire to take 25° as the normal, and still wish to avoid the trouble of going over all the calculations, I would suggest that by adopting 25·3° as a normal; they can easily obtain the desired corrections by subtracting 0·002, which is

* The reason that the apex is at 6° instead of 5°, is that expansion for 1° at 5° is 0·000022 (see Table No. II.), which is less than 0·000026, the expansion of glass.

the expansion corresponding to 25·3°, from those already given. The [illegible] will then become :—

[illegible]	Centigrade.
−0·002	„ 15·0 „
[illegible]	„ [illegible] „
−0·001	„ 20·75 „
−0·0005	„ 23·2 „
0·000	„ 25·3 „
0·0005	„ 27·3 „
[illegible]	„ [illegible] „
[illegible]	„ [illegible] „
0·0015	„ 31·2 „
0·002	„ 32·8 „
0·0025	„ 34·5 „
0·003	„ 36·1 „
0·0035	„ 37·6 „
0·004	„ 38·8 „
0·0045	„ 40·4 „
0·005	„ 41·6 „
0·0055	„ 42·9 „
0·006	„ 44·2 „
0·0063	„ 45·0 „

From these numbers, by proceeding in the same manner as before, we may obtain a thermometric scale, in which [illegible] is the normal, and the factors on the right of the tube are arranged as in Fig. 3.

ON THE MANUFACTURE OF IODINE.

By E. C. C. STANFORD, F.C.S.

ALTHOUGH comparatively a small industry, the manufacture of iodine is peculiarly interesting here, as from the first it has been almost confined in Great Britain to this city. I have therefore been requested to compile a paper on the subject.

Iodine was discovered by Courtois in 1812, but it was not made here in quantity till about the year 1841. The imports of kelp in that year into Clyde amounted to 2565 tons: kelp was then used for soap-making, and the iodine was extracted from the leys of the soap-boilers. In 1845 there were four small works engaged in the manufacture of iodine, mostly using soap-leys. In 1846 these were increased to twenty, the majority lixiviating kelp direct. The imports of this material increased in 1845 to 6000 tons. Owing, however, to the remarkable fluctuations in the price of iodine, and the extremely variable character of the crude material or kelp employed, one maker after another gave up working it, and now there are only three makers of iodine in or near Glasgow.

The sudden fluctuations in the price of iodine, ranging from 4s. per lb. to 34s. per lb. (the extreme points reached), while the price of the raw material did not materially vary, have involved many manufacturers in heavy losses, the profits in high times having generally fallen to speculators, and the losses in low times to the manufacturers. The whole manufacture is so limited that it has afforded unusual temptations to speculators. The table below shows the imports of kelp into Clyde and the price of iodine for the last thirty-five years.

The lixiviation of kelp as at present practised here is a simple process. The kelp is broken up into pieces the size of road metal, and lixiviated in vats coupled and heated by steam, similar to those employed in the lixiviation of blackash; the solution is run off at about 40° to 45° T. This is evaporated in ordinary open boiling-pans (9 feet diameter), and the salts which deposit are fished out. At about 62° T. a rough salt is deposited, consisting of 50 to 60 per cent of potassium sulphate, combined with sodium sulphate and chloride. The hot liquid is then run into iron coolers, generally cylindrical and of cast-iron, and a crop of potassium chloride crystallises out in about three days. The mother-liquor is again boiled down three times for good drift kelp, and after each boiling kelp salt is deposited and fished out, and the hot liquor is again run into the coolers, and another crop of potassium chloride obtained. These successive crops will range in strength from 80 per cent to 95 per cent of potassium chloride. The mother-liquor, having a density of 85° to 95° T., is then mixed with about one-seventh part of oil of vitriol, 145° T., and allowed to settle for twenty-four hours; the sulphurous compounds are decomposed, and sulphur is precipitated. The liquid is then distilled with peroxide of manganese in an iron still having a leaden cover and two arms; these are connected with two series of stoneware udells, in which the iodine is condensed in hard masses. After the iodine has been driven off, more peroxide of manganese is added, and the leaden arms are connected with another simple condensing apparatus, either of lead or earthenware, and the bromine collected therein. The makers are Messrs. W. and M. Paterson, Mr. Hughes, from kelp, and the North British Chemical Company from seaweed. I mention these particularly, for nearly all the chemical manuals refer to a maker, and his method, both of which have been things of the past for

Kelp Imports into Clyde, Years ending June 30.

	1856.	1857.	1858.	1859.	1870.	1871.	1872.	1873.	1874.	1875.
Tons of kelp	5855	8174	8116	8978	9257	9384	10,049	9449	10,923	8643
Price of iodine per lb...	10	12	12 8	13	12 8	14 4	34	24 8	15 8	10 8
	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865
Tons of kelp	6341	8641	8123	8190	7754	9722	9414	14,018	11,349	13,741
Price of iodine per lb...	13 8	12/4	10 6	9 8	8 6	7	5/8	5/	8 4	7 8
	1846.	1847.	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.
Tons of kelp	3927	4990	4490	4731	11,421	7320	5418	6491	4679	5826
Price of iodine per lb...	21 3	11/	11	11	10 8	8 8	15/	15 4	12,	13 4
						1841.	1842.	1843.	1844.	1845.
Tons of kelp						2565	1887	1965	3263	6086
Price of iodine per lb...						5/	4,8	6,	12,	31,1

Fluctuations.

Average.	Ten Years, 1866 to 1875.
9187	8116 in 1868 to 10,923 in 1874.
15 11½	10/ in 1866 to 34/ in 1872.
Average.	Ten Years, 1856 to 1865.
9730	6349 in 1856 to 14,018 in 1863.
8 10	5/ in 1863 to 13/8 in 1856.
Average.	Ten Years, 1846 to 1855.
5811	3627 in 1846 to 11,421 in 1850.
12 11	8 8 in 1851 to 21 3 in 1846.
Average	Five Years, 1841 to 1845.
3133	1887 in 1842 to 6086 in 1845.
11 9	4,8 in 1842 to 31,1 in 1845.

over thirty years. Even Watts's "Dictionary," usually so accurate, repeats this error. Messrs. Paterson, of this city, who have for some years been the largest makers of iodine, have an excellent method of boiling down by steam, which is used also in some other chemical works here. The liquors are boiled down in large cylindrical wrought-iron vats, heated by a coil of steam piping, and aided by a mechanical stirrer. This method of boiling is said to effect a saving of fuel and labour, and is more cleanly in use than open pans.

The products obtained are iodine, bromine, "muriate," containing 80 to 95 per cent potassium chloride; "soft sulphate," containing 50 to 65 per cent potassium sulphate; "kelp salt," containing sodium chloride, and 5 to 10 per cent alkali; "kelp waste," containing mostly calcium carbonate and silica, used in the ordinary glass bottle works; and "sulphur waste," containing dry about 70 per cent sulphur. All these products retain iodine, and some require most careful washing to extract it.

The whole process has undergone little change for several years, because it furnishes at once good dry iodine fit for the market. In France, where a process of precipitation by chlorine is adopted, the iodine is obtained as a moist powder, and must be re-sublimed for the market, or made into potassium iodide.

Although the lixiviation of kelp is a small manufacture, the making of the raw material has been for more than a hundred years the chief support of thousands of poor crofters and cotters in Ireland and the West Highlands. The history of this manufacture is very interesting. It has never been written, and I fear never will be. A complete record of the imports o f kelp into Clyde from the earliest period and the values would have been most instructive, as even the history of the alkali trade is not complete without it. Unfortunately, however, the Clyde tonnage books previous to 1859 have been disposed of to the paper mills, and the table of imports for the last thirty-five years in this paper was compiled with difficulty from indirect sources. I cannot help expressing my surprise that the Clyde Trust authorities, who have lavished expenditure on their noble river, should deem it worth while to sell such valuable records as waste paper. At one time a considerable quantity of kelp was also sent to Liverpool.

Kelp was first introduced about the middle of last century, and was employed in commerce for the sodium carbonate it contained. At the beginning of the present century it was worth from £20 to £22 per ton, and the western islands of Scotland alone produced 20,000 tons. The importation of Barilla then began, and during the twenty-two years ending 1822 the average price was only £10 10s. The duty was then taken off Barilla, and kelp fell to £8 10s., and in 1823, on the removal of the salt duty, it fell to £3, and in 1831 to £2. From then till 1845 it was still used in the soap and glass factories of Glasgow. In 1845 the manufacture of iodine commenced in earnest, and kelp was again in demand. But the kelp required was not the same, that which contained the most soda containing the least iodine. Moreover, it became valuable as a source of potassium chloride, the richer kelps in iodine containing the most, and this salt at one time was worth £25 per ton. The discovery of the Stassfurt mineral speedily reduced this price to about a third, and the further discovery of bromine in this mineral also reduced the price of that element from £1 18s. per lb. to 2s., about its present price. The amount of bromine produced from kelp is small, about a tenth of the iodine, and the total produce of France and Scotland is far exceeded by that of Germany alone: it is also imported in considerable quantity from America.

Manufacturers are now threatened with a still more formidable rival in iodine from the mother-liquors of the caliche of Peru. The total production of iodine here is 1000 to 1200 cwts., from about 10,000 tons of kelp. The production in France is rather less—about 800 tons, derived from double the amount, or 16,000 tons, of a kelp inferior in yield. The iodine in the caliche is estimated at 0·16 per cent, or 3·58 lbs. to the ton; and as about 600,000 tons are annually worked, if the whole of the iodine could be extracted it would amount to 18,750 cwts., or more than nine times the present total production. Even allowing that this is an over-estimate, and reducing it by a third, and then allowing half as the possible produce, it still leaves 6000 kegs as an output, or three times the present production. The makers there have, however, considerable difficulties to contend with; the iodine exists as an iodate, and the extraction cannot be effected completely. If, however, it could be extracted to any great extent, the smallness of the market would soon reduce the price below any possibility of profit, unless some new outlet can be found. We have no certain information as to the processes of extraction employed in the works at Peru, as they are kept very secret, and have been often changed; the iodine was at first exported as iodide of copper, and then as a crude iodine, containing about 50 per cent of iodine. It is now made of good quality, and it is probable that the iodine is reduced and precipitated by sodium bisulphite, and then re-sublimed.

We depend here entirely on the sea for our supply of iodine; according to Sonstadt it exists in sea-water in the form of calcium iodate: he estimates that it is present in the proportion of 1 in 250,000, and that a cubic mile of sea-water contains 11,072 tons. It is, however, much more difficult of detection than bromine, which, according to the same authority, exists as—

Bromine	1 in 3,333 parts.
Iodine	1 in 368,110 ,,

This is a high estimate compared to that of other authorities, who estimate the proportion of iodine at only 1 in 30,000,000. Certain species of Algæ have a remarkable power of eliminating and concentrating in their tissues these two elements, but as a rule they take up ten times as much iodine as bromine. I showed, some years ago, by a large number of analyses, that, though all the Algæ contain iodine, only a few species contain it in quantity. The following table gives the percentage amount of iodine in several Algæ. In my own figures I have taken the average of a number of analyses of the same plant, collected at different seasons all round the shores of Great Britain and elsewhere, widely distributed, especially in the first five plants from which all the kelp is made.

The following table shows the proportion of iodine contained in 100 parts of the dried Algæ, according to various authorities:—

	Sarphat	Schweitzer.	Godechens.	Zenger.	Wallace.	Stanford.
Laminaria digitata	0·135	—	0·625	—	0·4440	{A. Stem 0·4535 B. Frond 0·2946
,, saccharina	0·230	3·880	—	—	0·2880	C. 0·2794
Fucus serratus	0·124	0·058	0·177	—	0·0565	D. 0·0856
,, nodosus	—	—	0·074	—	0·0396	E. 0·0572
,, vesiculosus	0·001	—	—	—	—	F. 0·0297
Zostera marina	0·0005	—	—	—	—	0·0457
Rhodomela pinnastroides	—	—	—	—	—	0·0378
Hyderix siliquosa	—	—	—	—	—	0·2131
Hymanthalia lorea	—	—	—	—	—	0·0892
Chordaria flagelliformis	—	—	—	—	—	0·2810
Cladophlora glomerata (fresh-water)	—	—	—	0·0227	—	—

A. Average of 18 specimens.
B. ,, 23 ,,
C. ,, 5 ,,
D. ,, 12 ,,
E. ,, 4 ,,
F. ,, 8 ,,

To show the general character of some of these specimens, I may add that they were taken from Larne, Ballina, Sligo, Galway, and Skibereen, in Ireland; Shetland, Tyree, Coll, Colonsay, Tobermory, Vallay, Baleshare, Boreray, Neisker, Stornoway, Skye, Tyree, Kilcreggan, Iona, Dunbar, Fife, in Scotland; Scarborough, Weymouth, and Worthing, in England; Peele, in the Isle of Man; also from Norway, Denmark, and Iceland.

The first five varieties in the table are those employed in making kelp, and are named in the order in which they contain iodine. The best is the *Laminaria digitata*, or deep sea tangle growing on rocks and always submerged; the next is the *Laminaria saccharina*, or sugar wrack (so-called because it is often covered when dry with a sweet efflorescence of mannite); this variety grows on sand or on loose stones, also submerged, but in shallow water. These two varieties are called drift weeds, because they are thrown up by storms. All the *Fuci* grow on the rocks and are all exposed at low water. These are cut from the rocks and are known as cut weeds. The *Fucus serratus*, or black wrack, is the longest submerged, and is the nearest to low water. This weed is said to contain silver; I have not, however, been able to detect this metal, though working on a considerable amount of the ash. The next is the *Fucus nodosus* or knobbed wrack, less submerged, and poorer in iodine. The least submerged and the poorest in iodine is the *Fucus vesiculosus*, or bladder wrack. Kelp made from the drift weeds will contain about four times as much iodine as that from the cut weeds; indeed, at present prices the latter kelp is almost worthless, some of it containing less than 3 lbs. of iodine to the ton, and worth about £1 per ton. As this involves the cutting, carrying, drying, and burning of 20 tons of wet seaweed in a very wet climate, no wonder the employment is dying out, and little of this kelp is now made.

The manufacture of kelp as generally carried out is wasteful in the extreme. The seaweed is spread out to dry on the shore in a climate subject to heavy rains whereby the kelpers' labour is often entirely lost. It is burnt in long kilns made of loose stone walls and turf; the burning seaweed here attains a very high temperature. This part of the work is done by women and children; the men of the family are then employed with iron clats to rake the ash up until it forms a molten slag. During this laborious process more than 50 per cent of the iodine is often dissipated, and a large amount of potash; indeed, so intense is the heat that sufficient soda is volatilised to give an intense monochromatic flame, and to render the sight of those working at the kiln at night like the last scene of a terrible melodrama. The high temperature also enables the carbon to deoxidise the alkaline sulphates to sulphides and other sulphur compounds; these become concentrated in the mother-liquor, and entail a large expenditure of oil of vitriol, and give rise to great nuisance in the lixiviation. It will be readily seen also that large amounts of sand and earth, stones and gravel can be thus raked into the kelp, and it is often enormously adulterated; so general is this adulteration that the kelp ton is in many places increased to 22½ cwts. to allow for it. The presence of silica sand greatly assists the volatilisation of the iodine.

Very little of the winter supply is collected on account of the difficulty of drying it, and this is the richest in iodine. These evils have been long known and often pointed out, especially by the late Mr. D. McCrummen and Dr. Wallace—the latter having suggested the rational remedy of burning to a loose ash; but such is the extreme difficulty of convincing the people that it is possible to change their ways, that after repeated efforts I have signally failed getting any improvement in this direction. The kelp made in the old time was from cut weed and the kelpers learned to burn it into a dense vitreous slag, and they persist in doing the same as their fathers before them, although the purpose for which it is now required demands exactly opposite precautions. In one island I took away all their kelp irons to prevent this poling; but arriving late one night near the scene of a kelp burning I saw the familiar yellow light arising from a kiln where several men were engaged in making themselves hideous in driving off, by hard night work half the weight and value of their produce. Yet they will not burn it into ash because they do not believe it would be heavy enough; the fact being that although the produce is lighter the actual yield is largely increased.

In 1862 I published a series of researches on the destructive distillation of seaweeds, which still further showed the enormous waste in kelp burning, and for which the Society of Arts awarded their silver medal. The researches were conclusive as to the loss of iodine by the ordinary method, and from experience since on the large scale I know it to have been considerably understated. The researches showed the necessity of carbonising the seaweed in a close vessel. By this process an extremely porous charcoal was obtained which, on lixiviation, furnished the whole of the iodine and salts present in the original weed; the yield of this charcoal was double that of kelp, and the produce of iodine more than double that from the kelp. Ammonia, acetic acid, naphtha, and tar were also obtained as products of distillation, and a considerable quantity of lighting gas.

The residual charcoal after lixiviation is new to commerce. It is a remarkably porous body with an extraordinary power of absorption and deodorisation. Its composition is about midway between that from wood and that from bone in the proportion of carbon, but in general composition it much resembles the latter, from which it differs in containing more carbon, and carbonates of calcium and magnesium, and less phosphates. This substance can be obtained at a fourth the price of any other charcoal, and it exceeds them all in deodorising power; it is well worth the attention of chemists, as it could be obtained in large quantity, and has hitherto met with but a limited application. The usual composition of the two varieties is shown in the following table; the analyses are given for dry charcoal, but it is remarkably retentive of moisture.

Analyses of Residual Charcoal.

	Average Charcoal from	
	Laminaria.	Fucus.
*Carbon	52·54	70·32
Phosphates	10·92	1·90
Calcium carbonate	15·56	10·25
Magnesium carbonate	11·34	7·92
Calcium sulphate	—	1·93
Alkaline salts	5·70	1·84
Silica	3·94	5·84
	100·00	100·00
*Containing nitrogen = ammonia	1·75	2·30

The advantages of this method are that by retaining the whole of the iodine, and by utilising the winter supply, it largely increases the yield of iodine from a given extent of shore, and the manufacture being continuous gives much more employment to an indigent population, and it gives rise to a residual product of considerable value.

The process has only been carried out on the large scale on the Islands of Tyree and North Uist, in both which islands the people have enormously benefitted. I need only refer to the evidence of His Grace the Duke of Argyll before the Privy Council last year to prove this statement. That it will be greatly extended I have no doubt, when other proprietors of extensive shores, who have not hitherto shown the sagacity and foresight of His

Grace, will see the advantage of improving the local industry of their people instead of sending them away to improve other lands.

In concluding this short paper I would add that although my process is a great improvement in the manufacture of iodine it is not a general means of utilising seaweed, it is only applicable (unless a large demand arises for the residual charcoal) to the rich drift-weeds. The large fringe of cut weeds surrounding our shores, and easily accessible, is now almost unutilised except for manure. In a paper before the Chemical Society I have already pointed out the remarkable composition of the ash of seaweed as being more like that of an animal than that of a vegetable, lying as it does close to the border line of the two kingdoms. I hope before long to have something to say on the actual composition of the seaweed itself; the subject presents a large field for inquiry and is comparatively untrodden.

POSTSCRIPT.—Since this paper was read M. Thorwald Schmidt, the director of the Chemical Works at Aalborg, in Denmark, has proposed the working of kelp in connection with the manufacture of soda by the ammonia process. He claims to have reduced the loss of ammonia to under 2 per cent of the sulphate used. The samples of sodium carbonate forwarded to me by M. Schmidt are of great purity. His only difficulty is the utilisation of the residual liquor containing chlorides of sodium and calcium. This liquor is not worth boiling down there to recover the salt, and from the high import duty on salt it is too valuable to throw away. He proposes to utilise the alkaline sulphates in the kelp leys as precipitants for the calcium, retaining the alkalies in the liquor as chlorides. This process is quite feasible: calcium chloride was at one time used in some kelp works for the purpose of converting the sulphates of potassium into chloride, which was then much more valuable. After the iodine has been precipitated as iodide of lead the solution is boiled down and nitrate of sodium added, the potash being all crystallised out as saltpetre. The residual chloride of sodium solution is used again in the ammonia soda process. The principal seaweed on the Denmark shores is the *Zostera marina*, and the *Fuci*. I have examined several of these Danish seaweeds; all are poor in iodine, but the *Fuci* are particularly suitable for this purpose, being rich in alkaline sulphates.

Glasgow.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 19, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors, confirmation of the minutes of the previous meeting, &c., the following certificates were read for the first time:—W. H. Ellis, W. Lapraik, J. L. Notters, I. Scarf, H. G. Stacy. The following papers were read:—

"*On the Estimation of Manganese in Spiegeleisen, and of Manganese and Iron in Manganiferous Iron Ores*," by E. RILEY. 1. *Estimation of Manganese in Spiegeleisen.* There are two methods now in use:—(*a*) *The Direct Method.*—The pulverised spiegeleisen (about 1 grm.) is dissolved in dilute nitric acid, sp. gr. 1·2, a little chlorate of potash and hydrochloric acid added to destroy the soluble organic matter from the combined carbon; the solution, diluted to about a litre, is neutralised with carbonate of soda or ammonia, acetate of soda or ammonia added, the solution boiled, the basic peracetate of iron allowed to settle and filtered off. This precipitate is re dissolved in hydrochloric acid, and the process repeated to ensure complete separation of the manganese. The filtrates are evaporated to 1½ litres, allowed to cool, 2 to 4 c.c. bromine added, the solution well shaken, 0·880 ammonia added in excess, the solution heated gradually for an hour, boiled for a few minutes, the precipitate allowed to settle, filtered (the filtrate should be evaporated and tested for manganese) dried, and ignited in a muffle or over a gas blowpipe for half an hour. (*b*) *The Indirect Method.*—The finely powdered spiegeleisen (about 1 grm.) is dissolved in dilute sulphuric or in hydrochloric acid, the liquid diluted with recently-boiled, cooled, distilled water, and the iron estimated volumetrically; to the percentage of iron thus obtained 5 per cent is added for carbon and impurities, the difference is assumed to be manganese. The results obtained by this method are usually too low, from the formation of soluble organic matter during the process of solution. This error can be obviated by using nitric acid for a solvent, evaporating to dryness and heating; the oxides of iron and manganese are then dissolved in hydrochloric acid, the solution largely diluted, and reduced with sodium sulphite. Results obtained thus agree very closely with the direct method. The author gives 14 analyses showing that the addition of 5 per cent for impurities to the percentage of iron is a fair one. Thus, for all practical purposes, the indirect method is sufficiently accurate, and can be accomplished in one hour, the direct requiring five or six hours. The author strongly recommends the use of acetate and carbonate of ammonia instead of the corresponding soda salts in the direct method, and proves, by check experiments with pure sulphate of manganese, &c., the statements of Fresenius and others, that the presence of ammoniacal salts prevents the complete precipitation of manganese by bromine and ammonia, to be erroneous. On the other hand, if soda salts be used the ignited precipitate will contain soda. The author considers that sulphur cannot exist in spiegeleisen. He determines the carbon by dissolving the iron in neutral chloride of copper, and after complete solution of the iron and precipitated copper the carbon is filtered on asbestos, and burnt with oxide of copper in a current of oxygen; the carbon determinations by the colour test are unsatisfactory for high percentages of carbon. According to the author the percentage of carbon varies with the percentage of manganese. The methods of Mr. Parry (CHEMICAL NEWS, vol. xxix., p. 86) and of Mr. Galbraith (vol. xxxiii., p. 49) were considered and stated to be undesirable methods. 2. *Estimation of Manganese in Manganiferous Iron Ores.*—These ores contain baryta, many contain oxide of zinc, and some potash or soda in appreciable quantities. The use of ammoniacal salts as mentioned in the previous part of the paper prevents any large error from the presence of the oxide of zinc, but it is difficult to get rid of the baryta; even in the presence of sulphuric acid it remains in combination with the manganese, and is precipitated with it unless special precautions be taken. Lime, if present, may also be precipitated with the manganese. After insisting on the importance of taking fair samples and of determining all the constituents directly, the author gave the following process as the one which yielded the best results:—1 grm. of the ore dried at 100° C. is dissolved in hydrochloric acid, the siliceous matter separated by filtration, and the larger portion of the free acid driven off. The liquid is made up to about ½ of a litre, and allowed to stand for four hours, after adding a few drops of sulphuric acid to separate any baryta. The solution is now diluted to about 1 litre, neutralised with ammonia after the addition of acetate of ammonia; boiled, allowed to settle, and filtered; the unwashed precipitate is re-dissolved in hydrochloric acid, and again precipitated with ammonia and acetate of ammonia. The basic peracetate of iron, after settling, is filtered off and washed three or four times with boiling distilled water, containing a few drops of acetate of ammonia. The filtrate is evaporated to 1½ litres, when cold, 2 to

4 c.c. of bromine added, and the process completed as described above. After ignition the precipitate should be dissolved in a small quantity of hydrochloric acid, the residue, if any, filtered off, a drop of sulphuric acid added, and the precipitate, if any occurs, separated. It is most important to test the ignited Mn_3O_4 for impurities, baryta, zinc, lime, &c. Chlorine can be substituted for bromine, but without advantage. The sulphide of ammonium process the author considers to be most objectionable. 3. *Estimation of Iron.*—The author recommends a standard solution of bichromate of potash, the results being usually a little high. As a reducing agent sulphite of soda prepared in the laboratory is used, the purchased samples being always impure; bisulphite of soda should not be used. The percentages of iron in 60 samples of steel rails are given, determined by weighing as Fe_2O_3 and by standard solution of bichromate of potash; the mean difference between the two methods is 0·073 per cent.

Dr. Gladstone said that the Society must feel greatly indebted to Mr. Riley for giving them the benefit of his experience in so elaborate a manner, especially as the determination of manganese had now become a matter of such great importance.

Mr. Field asked if Mr. Riley had tried hydrated oxide of lead in suspension for effecting the separation of barium, manganese, and iron; cobalt and nickel were entirely separated from iron by its use.

Mr. Riley said that the acetate of ammonia process was so beautiful that he should prefer it, and, besides, there would be the additional trouble of getting rid of the lead. In answer to Mr. Heathfield, the barium, in the case of a sample of ore containing 14·87 per cent Ba, was combined with the manganese.

"*On a Method of Detecting Small Quantities of Bismuth*," by M. M. Pattison Muir, F.R.S.E. The author finds that the following test-liquid (see "Researches on Bismuth," by R. Schneider, *Pogg. Ann.*, lxxxviii., p. 45) is a very delicate qualitative test for bismuth:—12 grms. crystallised tartaric acid and 4 grms. stannous chloride are dissolved in caustic potash, so as to produce a clear liquid having a distinctly alkaline reaction: this liquid must remain clear at 60° to 70° C. To the liquid to be tested is added a considerable quantity of tartaric acid. It is warmed, and made alkaline with caustic potash. A few c.c. of the stannous chloride solution (which the author proposes to call Schneider's reagent) are now added, and the mixture warmed to 60° to 70° for a few minutes. If bismuth is present a brownish black colour is produced, from the formation of hypobismuthous oxide (Bi_2O_2). 1 part of bismuth in 210,000 parts of liquid may be thus detected. The absence of mercury must be secured before applying the test. Copper and manganese interfere slightly; lead, arsenic, antimony, iron, cobalt, nickel, and chromium not at all. The author hoped to have perfected a volumetric method from the above reaction, but has not succeeded.

Mr. Field mentioned that the precipitation of iodide of lead was an exceedingly delicate test for the presence of bismuth. If no bismuth was present the iodide of lead was precipitated of the usual yellow colour if one-thousandth part of bismuth was present; the precipitated iodide was of a distinctly darker colour.

"*On Certain Bismuth Compounds (Part V.)*," by M. M. Pattison Muir, F.R.S.E. By precipitating a nearly neutral solution of bismuth nitrate with potassium ferricyanide, washing by decantation, and drying *in vacuo* over sulphuric acid, pure bismuth ferricyanide is prepared as a tawny yellow amorphous powder with a shade of green. Its formula is $Bi_{35}FeCy_6$. It is unaltered in moist or dry air; suspended in boiling water, hydrocyanic acid is evolved; it is partially decomposed by drying at 100° C. By the action of chlorine, bromine, and nitric acid bismuth ferrocyanide is converted into bismuth ferricyanide. The ferricyanide is decomposed by the action of chlorine when suspended in water, or in the presence of cold or hot solutions of caustic soda. A method for analysing bismuth ferrocyanide and bismuth ferricyanide is given. Bismuth ferricyanide is converted by sodium amalgam into the ferrocyanide. When heated in closed crucibles both salts yield a black brown mass containing iron, bismuth, carbon, and small quantities of cyanogen.

"*Notes on Madder Colouring Matters: Munjistin, Purpurin, and Purpuroxanthic Acid* (Continuation)," by E. Schunck, Ph.D., F.R.S., and H. Roemer, Ph.D. *Munjistin.*—The authors found this substance to resemble purpuroxanthic acid, softening at 125°, fusing at 130°; when further heated it evolved carbonic anhydride, and was converted into purpuroxanthin. After criticising the conclusions of M. Rosenstiehl (*Comptes Rendus*, lxxxiii., 827), who states that his purpurin is identical with purpuroxanthic acid, and that the latter is formed from pseudopurin, the authors claim, having been the first to discover among this series of bodies one containing a carboxyl group, to be left for the present in undisturbed possession of the field they have opened up, *i.e.*, the preparation and examination of such members of the series as are formed from alizarin and its isomerides, as well as from the isomerides of purpurin by the substitution of nH by nCOOH. *Purpurin.*—The specimen examined had a melting-point which remained constant after it had been converted into the acetyl compound and again liberated. Its formula was $C_{14}H_8O_5$: it was easily soluble in boiling spirits of wine, yielding a yellow solution, from which it crystallises on cooling in thin flattened prisms of a deep orange colour. The crystals lose water at 100° C., and contain 1 molecule of water. Purpurin melts at 253°, but begins to sublime at 150° in red plumose or acicular crystals. It is slightly soluble in boiling water, and dissolves in ether, readily in carbon disulphide, benzol, and glacial acetic acid. It dissolves in concentrated sulphuric acid, in caustic potash, soda lye, sodium carbonate solution, and ammonia. These solutions give absorption spectra. In alcoholic potash and soda purpurin is almost insoluble. It forms with baryta and lime-water purple lakes. A solution of purpurin in caustic alkali loses its colour on exposure to the air, the purpurin disappearing entirely: this is due to oxidation. Purpurin dissolves in boiling alum liquor, forming a pink fluorescent solution containing purpurin in a loose combination with alumina. This solution is precipitated by the addition of a little sodium carbonate or ammonia, though the liquid may still retain an acid reaction. An alcoholic solution of purpurin gives with lead acetate a crimson precipitate soluble in excess of alcoholic lead acetate; the precipitate obtained with alizarin is insoluble in excess. With copper acetate purpurin in alcohol gives a dark reddish yellow precipitate; a solution of alizarin becomes purple, but gives no precipitate. *Triacetyl-purpurin* softens at 193°, and melts at 198° to 200° C. It is decomposed by dilute caustic potash, yielding purpurin; analysis gave the formula—

$$C_{13}H_5(C_2H_3O)_3O_5.$$

Brom-purpurin is obtained by digesting purpurin with carbon disulphide containing bromine at 150° to 200° C. It crystallises from glacial acetic acid in dark red needles melting at 276°. Its properties resemble those of purpurin. Its formula is $C_{14}H_7BrO_5$. By heating pure purpurin for 6 to 7 hours in sealed tubes to 300° C., a small quantity of quinizarin is formed, and a quantity of by-products; no alizarin is formed. Quinizarin crystallises in bright red needles, melting at 193° to 194° C. Its ethereal solution is strongly fluorescent. It is soluble in alum liquor, giving a red solution with two absorption-bands.

The Society then adjourned to May 3, when the following papers will be read:—(1) "On some Points in Gas Analysis," by J. W. Thomas; (2) "On Nitroso-β-naphthol," by Dr. Stenhouse and Mr. Groves; (3) "On the Action of Pyrogallate of Potash on Nitric Oxide," by W. J. Russell and W. Lapraik; (4) "Asbestos Cardboard, and its Uses in the Laboratory," by W. N. Hartley.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Moniteur Scientifique, Quesneville.
March, 1877.

New Process for Determining the Co-efficient of Purity of Saccharine Solutions.—P. Casamajor.—Incapable of useful abstraction.

Poison of Putrid Matters, Bacteria, and Blood-Poisoning.—Dr. P. L. Panum, with Critical Observations by Ch. Blondeau.—A lengthy paper, which can scarcely be regarded as chemical.

Studies on Beer.—M. Pasteur, abstracted by Ch. Graham.—Translated from an English source.

Analytical and Industrial Examination of an Egyptian Petroleum.—F. Weil.—The specific gravity of this petroleum is 0·953, whilst the oils from Pennsylvania and Canada range from 0·790 to 0·830. It yields a superior lubricating oil, free from tarry matters, and a lighting oil of inferior quality. It is especially adapted for heating marine steam-boilers, as it does not take fire below 135° C.

Manufacture of Indian Sarrongs, of the "Batick" Style.—A. Schultz.—Detailed directions for imitating these cloths, as produced in Java.

True Sense of the Words "Iron" and "Steel."—L. Gruner.—Substantially a report which has appeared in the *New York Mining Journal* (Oct. 28th, 1876, p. 278).

New Battery with Peroxide of Manganese.—G. Leclanche.—Taken from the *Comptes Rendus*.

April, 1877.

Purification of the Seine.—Hip. Stupuy.—A long and unimportant treatise.

Report on Saccharimetric Methods, and the Yield of Crude Sugars on Refining.—MM. Bardy, de Luynes, Girard, and Riche.—Incapable of useful abstraction.

New Igniter for Automatic Torpedoes.—MM. Champion and Pellet.—Unintelligible without the accompanying figure.

Review of Foreign Researches.—E. Noelting.—The papers here given are taken from the *Berichte der Deutschen Chem. Gesellschaft*, and consequently have been, or will be, noticed under that head.

On Nitrification by Means of Organic Ferments.—Th. Schloesing and A. Muntz.—Already noticed.

Reimann's Färber Zeitung, No. 13, 1877.

The principal article in this issue is an account of chrysoidin, by Dr. A. W. Hofmann, taken from the *Berichte de Deutschen Chem. Gesellschaft*.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 13, March 29, 1877.

The Abbé Moigno continues his denunciation of M. Flammarion.

The "Society against the Abuse of Tobacco" offers a prize of 200 francs to the medical man who shall bring forward the greatest number of interesting and unpublished observations on diseases caused by tobacco.

No. 14.

Absorption Radiometer.—M. Thore, of Dax.—This apparatus is described and figured. Its construction cannot be made intelligible without the accompanying illustrations.

A correspondent of *Les Mondes*, M. Nic, of Vienna, writes that a person in his district is in possession of a "certain cure" for rabies.

MEETINGS FOR THE WEEK.

Monday, April 30th.—Medical, 8.
—— Society of Arts, 8. (Cantor Lectures). "The Connection of Greek and Roman Art with the Teaching of the Classics," Sidney Colvin, M.A.
—— Zoological, 1. (Anniversary).
—— Philosophical Club, 6. (Anniversary).
Tuesday, May 1st.—Civil Engineers, 8.
—— Royal Institution, 2. (Annual Meeting).
—— Zoological, 8.30.
Wednesday, 2nd.—Society of Arts, 8. "Continuous Brakes for Railways" Capt. Tyler, R.E.
—— Meteorological, 8.
Thursday, 3rd.—Royal, 8.30.
—— Royal Institution, 3. "Heat," Prof. Tyndall.
—— Royal Society Club, 6.30.
—— Chemical, 8. "On some Points in Gas Analysis," J. W. Thomas. "On Nitroso-β-Naphthol," Dr. Stenhouse and Mr. Groves. "Action of Pyrogallate of Potash on Nitric Oxide," W. J. Russell and W. Lapraik. "Asbestos Cardboard and its Use in the Laboratory," W. N. Hartley.
Friday, 4th.—Royal Institution, 9. "Researches on the Origin and Development of Minute and Low Forms of Life," Rev. W. H. Dallinger.
—— Society of Arts, 8. (Indian Section). "Thaumatodendra, or the Wonders of Trees," with Illustrations from Life, Mr. William Tayler.
Saturday, 5th.—Royal Institution, 3. "Babylonian Literature," Rev. A. H. Sayce.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

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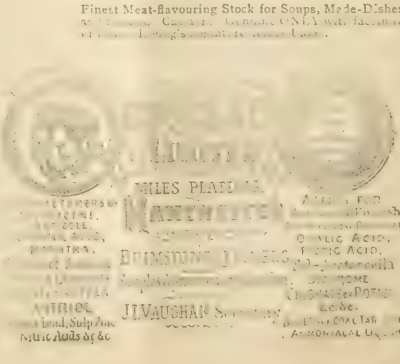

THE CHEMICAL NEWS.

VOL. XXXV. No. 910.

ON

REPULSION RESULTING FROM RADIATION.

PRELIMINARY NOTE ON THE OTHEOSCOPE.*

By WILLIAM CROOKES, F.R.S., &c.

I COMMUNICATED to the Royal Society, in November last, an account of some radiometers which I had made with the object of putting to experimental proof the "Molecular pressure" theory of the repulsion resulting from radiation. Continuing these researches, I have constructed other instruments, in which a movable fly is caused to rotate by the molecular pressure generated on fixed parts of the apparatus.

In the radiometer, the surface which produces the molecular disturbance is mounted on a fly, and is driven backwards by the excess of pressure between it and the sides of the containing vessel. Regarding the radiometer as a heat-engine, it is seen to be imperfect in many respects. The black or driving surface, corresponding to the heater of the engine, being also part of the moving fly, is restricted as to weight, material, and area of surface. It must be of the lightest possible construction, or friction will greatly interfere with its movement; it must not expose much surface, or it will be too heavy; and it must be a very bad conductor of heat, so as to retain the excess of pressure on one side. Again, the part corresponding to the cooler of the engine (the side of the glass bulb) admits of but little modification. It must almost necessarily be of glass, by no means the best material for the purpose; it is obliged to be of one particular shape; and it cannot be brought very near the driving surface.

A perfect instrument would be one in which the *heater* was stationary; it might then be of the most suitable material, of sufficient area of surface, and of the most efficient shape, irrespective of weight. The *cooler* should be the part which moves; it should be as close as possible to the heater, and of the best size, shape, and weight, for utilising the force impinging on it. By having the driving surface of large size, and making it of a good conductor of heat, such as silver, gold, or copper, a very faint amount of incident radiation suffices to produce motion. The black surface acts as if a molecular† wind were blowing from it, principally in a direction normal to the surface. This wind blows away whatever easily movable body happens to be in front of it, irrespective of colour, shape, or material; and in its capability of deflection from one surface to another, its arrest by solid bodies, and its tangential action, it behaves in most respects like an actual wind.

Whilst the radiometer admits of but few modifications, such an instrument as the one here sketched out is capable of an almost endless variety of forms; and as it is essentially different in its construction and mode of action to the radiometer, I propose to identify it by a distinctive name, and call it the Otheoscope (ωθέω, I propel).

The glass bulb is an essential portion of the machinery of the radiometer, without which the fly would not move; but in the otheoscope the glass vessel simply acts as a preserver of the requisite amount of rarefaction. Carry a radiometer to a point in space where the atmospheric pressure is equal to, say, one millimetre of mercury, and remove the glass bulb; the fly will not move, however strong the incident radiation. But place the otheoscope in the same conditions, and it will move as well without the case as with it. In the preliminary note already referred to*, I described a piece of apparatus by which I was able to measure the thickness of the layer of molecular pressure generated when radiation impinged on a blackened surface at any degree of exhaustion. At the ordinary density of the atmosphere the existence of this molecular disturbance was detected several millimetres off, and its intensity increased largely as the generating surface and movable plate were brought closer together. It would be possible, therefore, to construct an otheoscope in which no rarefaction or containing vessel was necessary, but in which motion would take place in air at the normal density.† Such a heat-engine would probably work very well in sunlight.

Aided by the mechanical dexterity of my assistant, Mr. C. H. Gimingham, I have constructed several varieties of otheoscope. These I propose to exhibit at the Soirée of the Royal Society on Wednesday next, as illustrations of the very beautiful manner in which, at this stage of my investigations, theory and experiment proceed hand in hand, alternately assisting each other, and enlarging our knowledge of those laws of molecular movement which constitute a key to the relations of force and matter.

The following is a list of the otheoscopes I have already made, together with some new experimental radiometers, which will be exhibited for the first time on Wednesday:—

1. *Otheoscope.*—A four-armed fly carrying four vanes of thin clear mica is mounted like a radiometer in an exhausted glass bulb. At one side of the bulb a plate of mica blacked on one side is fastened in a vertical plane, in such a position that each clear vane in rotating shall pass the plate, leaving a space between of about a millimetre. If a candle is brought near, and by means of a shade the light is allowed to fall only on the clear vanes, no motion is produced; but if the light shines on the black plate, the fly instantly rotates as if a wind were issuing from this surface, and keeps on moving as long as the light is near.

2. *Otheoscope.*—A four-armed fly carries roasted mica vanes, and is mounted in an exhausted glass bulb like a radiometer. Fixed to the side of the bulb are three plates of clear mica, equidistant from each other in a vertical plane, but oblique to the axis. A candle brought near the fixed plates generates molecular pressure, which, falling obliquely on the fly, causes it to rotate.

3. *Otheoscope.*—A large horizontal disk, revolving by the molecular disturbance on the surface of inclined metallic vanes, which are blacked on both sides in order to absorb the maximum amount of radiation.

4. *Otheoscope.*—Inclined aluminium vanes driven by the molecular disturbance from the fixed blacked mica disk below, blowing (so to speak) through them.

5. *Otheoscope.*—A large horizontal coloured disk of roasted mica, driven by inclined aluminium vanes placed underneath it.

6. *Otheoscope.*—A bright aluminium disk cut in segments, and each segment turned at an angle, driven by a similar one below of lampblacked silver.

7. *Radiometer.*—A vertical radiometer, made with eight disks of mica blacked on one side, and the whole suspended on a horizontal axis which works in two glass cups. The motion of the radiometer is assisted on each side by driving vanes of aluminium blacked on one side.

8. *Radiometer.*—A vertical turbine radiometer, the oval vanes of roasted mica blacked on one side.

9. *Radiometer.*—A spiral radiometer of roasted mica blacked on the upper side.

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* Read before the Royal Society, April 26, 1877. Received April 23, 1877.

† *Molecular*, not *molar*. There is no wind in the sense of an actual transference of air from one place to another. This molecular movement may be compared to the movement of the gases when water is decomposed by an electric current. In the water connecting the two poles there is no apparent movement, although eight times as much matter is passing one way as the other.

* *Proc. Royal Soc.*, Nov. 16, 1876, p. 310.

† Since writing this I have constructed such an instrument. The movement takes place in the way I had anticipated.—W. C., April 26, 1877.

10. *Radiometer* of large size, showing great sensitiveness.

11. *Radiometer.*—A two-disk radiometer, the fly carrying roasted mica disks blacked on one side; in front of each black surface is fixed a large disk of thin clear mica. The molecular disturbance set up on the black surface, and streaming from it, is reflected in the opposite direction by the clear plate of mica, causing the fly to move abnormally, *i.e.*, the black surface towards the light.

12. *Radiometer.*—A two-disk radiometer, the fly carrying roasted mica disks blacked on one side, similar to No. 11, but with a large clear disk on each side. The molecular disturbance, prevented from being reflected backwards by the second clear disk, is thus caused to expend itself in a vertical plane, the result being a total loss of sensitiveness.

13. *Radiometer.*—A two-disk, cup-shaped, aluminium radiometer, facing opposite ways; both sides bright. Exposed to a standard candle 3·5 inches off, the fly rotates continuously at the rate of one revolution in 3·37 seconds. A screen placed in front so as to let the light shine only on the convex surface, produces repulsion of the latter, causing continuous rotation at the rate of one revolution in 7·5 seconds. When the convex side is screened off, so as to let the light shine only on the concave, continuous rotation is produced at the rate of one revolution in 6·95 seconds, the concave side being apparently attracted. These experiments show that the repulsive action of radiation on the convex side is about equal to the attractive action of radiation on the concave side, and that the double speed with which the fly moves when no screen is interposed is the sum of the attractive and repulsive actions.

14. *Radiometer.*—A two-disk, cup-shaped, aluminium radiometer, lampblacked on the concave surfaces. In this instrument the usual action of light is reversed, rotation taking glace, the bright convex side being repelled, and the black concave attracted. When the light shines only on the bright convex side, no movement is produced, but when it shines on the black concave side, this is attracted, producing rotation.

15. *Radiometer.*—A cup-shaped radiometer similar to the above, but having the convex surfaces black and the concave bright. Light shining on this instrument causes it to rotate rapidly, the convex black being repelled. No movement is produced on letting the light shine on the bright concave surface, but good rotation is produced when only the black convex surface is illuminated.

16. *Radiometer.*—A multiple-disk, cup-shaped, turbine radiometer, bright on both sides, working by the action of warm water below and the cooling effect of the air above.

17. *Radiometer.*—A four-armed, metallic radiometer with deep cups, bright on both sides.

18. *Radiometer.*—A four-armed radiometer, the vanes consisting of mica cups, bright on both sides.

19. *Radiometer.*—A four-armed radiometer having clear mica vanes. The direction of motion being determined by the angle formed by the mica vanes with the inner surface of the glass bulb.

FORMATION OF MOSS COPPER, &c.

By W. M. HUTCHINGS.

I HAVE made a few more experiments on the above subject which may, perhaps, prove of sufficient interest for insertion in the CHEMICAL NEWS. It struck me that it would be very interesting to ascertain whether the singular growth of moss copper upon the surface of the regulus, at low temperature, as described in my former note, was dependent upon conditions which only result during cooling after fusion, or whether the same, or any, growth would take place on heating the regulus again after total cooling.

I had pieces of regulus from the former experiments, which had been kept in stoppered bottles for several weeks, some of them with "moss" on surfaces exposed while hot, and some with clean and bright surfaces, free from "moss," fractured when quite cold. No change of any kind had taken place during the time the pieces had been kept in the bottles. I took pieces of this regulus and fused again under borax, a piece of charcoal being placed in the crucible to prevent oxidation. The fused mass was poured into a mould and cooled rather rapidly, so that very little disseminated copper was formed. If a piece was broken off while still hot, moss grew on the surfaces, as before described. After complete cooling pieces were broken out from the button of regulus for experiment, and their surfaces very carefully examined with a lens, and under the microscope. They had the blue-black colour and lustre of the regulus, were perfectly free from all projecting filaments of copper, and only showed very small veins and nests of metal here and there, so small that they could not be seen with the naked eye at all.

These pieces were then placed in a covered crucible in an air-bath, which was heated for two hours to 300° C. After cooling, the pieces were examined again, when small points of metallic copper could be seen dotted about, even with the eye alone, where no such points were visible before the experiment. The surfaces were tarnished. Under the microscope these points of copper were seen to be filaments in various stages of protrusion; some just appearing, others projecting some little distance, but not sufficiently far to have become curled, and others, though fewer, which had grown out and become curled and twisted at the ends.

They were very unequally distributed over the surfaces, comparatively large spaces being quite bare or showing only a filament here and there, while smaller patches showed a thick growth. In all cases where they were sufficiently grown to be examined, the filaments were seen to be grooved and to be flattened, exactly as in former experiments. In many cases a patch of very minute filaments had grown among the larger ones, so minute that they could not be detected with a tolerably good lens, and were only seen under the microscope. Magnified 90 diameters they were still so minute that the grooving could not be seen, though, doubtless, they in all respects resemble the larger ones, being similarly curled and twisted.

But the most striking effect of the exposure to 300° C. was seen on breaking the pieces after the experiment, and contrasting the surfaces so exposed with the surfaces of bits broken off the pieces just before they were placed in the air-bath. *After* the two hours heating there is so much separated copper disseminated in little veins and bunches all through the regulus that the surface exposed has quite a reddish colour. The quantity of copper separated out and collected in well-defined veins and nests by this two hours' heating is truly astonishing. I have repeated the experiment many times, and always with the same result.

On exposing the same pieces again for two hours to 300° C. no apparent increase seemed to take place, either in the number and size of the projecting filaments, or in the amount of copper separated out. Exposure to 250° C. produced the same effects, but not quite as strongly. Several hours' exposure of 100° C. produced no effects.

Similar pieces of freshly-broken regulus were placed in small clay crucibles. Covers of porcelain crucibles were placed over the pieces, of such a size that they formed lids, as it were, at about half the depth of the clay crucibles. The clay covers were then well luted on with fireclay, only the very small vent-hole in the centre of the cover being left open. In this way the regulus was protected from oxidation. These crucibles were heated for two hours in a muffle to such a temperature that, in the darkened room, their lower portions were just distinctly red. They were then taken out and allowed to cool till all trace of redness was just gone, when they were opened; the regulus was seized with forceps, and examined with

a lens as rapidly as possible. At the moment of removal from the crucible, the only change apparent was the tarnish of the surfaces. No projecting copper was visible. But in the course of a minute or two copper filaments could be seen dotted about, even without the aid of the lens; and under the microscope just the same appearances were noted as after exposure to 300° C. If a piece was broken across the moment it was taken from the crucible, and the fresh surface examined instantly, it was seen to be blue-black, with no copper visible to the eye and very little with the lens—just like the surfaces of the pieces when first placed in the crucibles. But, again, in the course of a couple of minutes, a growth of filaments takes place, and on this fractured surface the growth is very much more rapid and plentiful than on the outer surfaces of the pieces as taken out of the crucibles, becoming as thick and velvety as those which I described in my former note.

When a piece is broken across after complete cooling, the surfaces are no longer pure blue-black. There is sufficient disseminated copper to alter the appearance slightly, but nothing approaching the quantity which separated on heating to 300° C. for two hours.

I quite expected to find that on taking these pieces of regulus from the crucibles there would be a very much larger quantity of copper filaments and of disseminated copper formed during the two hours' in the muffle than had been seen after heating to 300° C. only. I took them out and examined them while still hot, because it had struck me as just *possible* that a lower temperature caused these growths and separations even better than the red heat I had employed, and I wished to see the pieces before they had cooled down.

It would almost seem from these experiments that such is the case, and that the filaments and the disseminated copper are formed at a far lower temperature than has yet been supposed, and very little, if at all, at higher ones. In that case the reason for the observation which I have always made, that a larger and finer growth of moss is obtained when pieces of regulus are fractured while still very hot, would seem to be that when this is done the outer portions of the pieces soon cool down to about the range of temperature at which the moss forms most readily, and are kept longer within this range—250° to 300° C., or thereabouts?—by the hotter inner portions, than is the case when the pieces are allowed to cool further before breaking.

Why the moss grows much better on a freshly-exposed surface I cannot explain. When buttons of regulus have solidified in a mould under borax, this latter can usually be perfectly detached by a few taps with a hammer, leaving a fine smooth surface of regulus. Copper filaments will always appear upon this, but not nearly so plentifully as upon a surface of the same button exposed by breaking.

The whole subject is, I think, most interesting, and will repay plentiful experimentation and study. I hope that these notes may fall into the hands of somebody engaged in copper-smelting who may think it worth while to experiment upon large pigs of regulus.

I have prepared fused silver sulphide, heated it in the muffle as described by Prof. Liversidge, and obtained the same beautiful results. At the same time that a piece was exposed on an open scorifier, another piece of the same sulphide was placed in a luted crucible, as above described, with the regulus. They were left together in the muffle for the same length of time. The piece on the scorifier had a fine growth of moss silver upon it, while the one in the crucible had only two or three very small filaments and some minute projecting teeth. It seems as if free access of air were necessary for the growth of the moss in this case, though there is not the slightest sign of any oxidation of the sulphide taking place.

I have also prepared beautiful specimens of moss silver by the action of hydrogen and of steam upon silver sulphide. Anything more beautiful than the silver growth obtained in these well-known experiments cannot be imagined. In whatever manner obtained—by simple "roasting," by steam, or by hydrogen—the silver filaments present exactly the same appearance, and differ only from those of copper in the colour, and in being easily obtained much longer and thicker. They also exactly resemble filaments of native silver, so much so that threads of the same size could not be distinguished from each other if laid side by side.

In many cases I have observed silver filaments split up at the outer end into bunches of finer threads, as if the many smaller fibres by the union of which they are formed, had separated again under the twisting and bending to which they are subjected when they grow to any length.

Prof. Liversidge (Chemical News, vol. xxxv., p. 68) gives an experiment which he made of heating native copper disulphide (Redruthite) in hydrogen, by which he obtained "a nap of acicular filaments of copper." I am inclined to think, however, that the hydrogen in this experiment was not thoroughly dried, and that the copper was produced by the action of aqueous vapours. We are informed by most chemical authorities that copper disulphide is not decomposed by heating in hydrogen; and our most accurate method of analytically determining copper is based upon this fact, and strongly recommended by Fresenius, Rose, and others. It seems beyond doubt that, at all events at temperatures up to very bright redness, *perfectly dry* hydrogen has no action upon the disulphide. I have used the process for analysis so very often, and have so often carefully examined and tested the resulting disulphide, that I am quite sure no action ever takes place, and I think most analysts have the same opinion. But when the hydrogen is not most carefully dried copper is reduced. I have known this take place when the hydrogen was passed through a long tube of calcium chloride which had been used a little too long, and had lost some of its drying power. I find it necessary to pass the gas through a good column of strong sulphuric acid, and then through a long tube of well-prepared calcium chloride, after which no trace of copper can ever be detected, however long the heating is kept up.

It is generally stated in books on chemistry and metallurgy that copper disulphide is very little acted upon by aqueous vapour at red heat. In most works Regnault is quoted to this effect. "Watts's Dictionary" and "Gmelin's Chemistry" state, under Copper Disulphide, that "heated to redness in a current of aqueous vapour, it is but slightly decomposed; but at a white heat it yields large quantities of hydrogen gas and sulphuretted hydrogen, together with sublimed sulphur, and the copper is completely reduced to the metallic state."

Dr. Percy, in his "Metallurgy of Copper," also quotes Regnault, and gives experiments of his own, in which copper disulphide was heated nearly to whiteness in a porcelain tube in a current of steam. The disulphide used was artificially prepared, and had been fused. It was powdered for the experiment, but would at once fuse again at the heat employed. Dr. Percy does not say that he made any experiments at lower temperatures, or used any other disulphide. I have not seen the original details of Regnault's experiments, and the abstracts from them which I have seen in other works do not say what disulphide he used. I presume it was fused artificial disulphide. I have made many experiments, and find that small pieces of such disulphide are certainly not perceptibly acted upon by steam at a moderate red heat.

Copper sulphide was prepared in the wet way, dried, and heated for half an hour to redness in a current of dry hydrogen in the usual manner in a Rose's crucible. After cooling in hydrogen it was examined; it had sintered together, but fusion had not taken place except just in contact with the bottom of the crucible. No copper was visible under the microscope. The pieces were replaced in the crucible, covered with a well-fitting perforated lid, a glass tube of ¼ inch bore, which fitted the perforation, was passed through, and fixed with its mouth just above

the pieces of disulphide. A rapid current of steam was passed into the crucible, the tube bringing it from the large flask in which the water was boiled, being wrapped in copper foil and heated by gas-burners. The crucible was heated to dull redness. No air could possibly get to the disulphide, the steam escaping through the small spaces between crucible and cover with considerable pressure. After thus heating for forty-five minutes the crucible was allowed to cool in the current of steam and the contents examined. A very fine crop of copper moss had formed—in some cases all over the pieces, in others in patches. Some of the filaments were very fine ones; they had all the usual grooved and curled appearance. A good deal of red cuprous oxide had formed in patches here and there, and films of copper had been produced in some places by its action upon the underlying disulphide; but the amount of this action had been small, owing to the low temperature, and could only be seen under the microscope. There were large spaces where no oxide was visible, and it was mostly upon these that the finest copper filaments had formed, standing rooted in the sintered and shining disulphide.

In one experiment the heat was kept very low indeed, and was only continued for ten minutes; but this had sufficed to produce a large amount of minute moss.

Pieces of Redruthite the size of a pea were heated in the same manner in steam. It required more heat and longer time to produce any very perceptible action, but a piece kept for one hour at moderate redness produced a beautiful specimen. Large filaments had grown upon the Redruthite, preferably on the upper edges, some of them ¼ inch long. Under the microscope very many smaller ones could be seen in all directions. The pieces of Redruthite were not fused, except in contact with the crucible. They had become fissured in many places. Cuprous oxide had formed pletifully, and had reacted upon the disulphide very much more than in the last experiment, owing to the greater heat used. At many places on the surfaces layers of copper had formed in this manner; and the little fissures were full of veins of copper and cuprous oxide, presenting a most interesting and beautiful appearance, recalling to my mind many large specimens I have seen of Redruthite, cuprite, and metallic copper occurring together, differing only from the small artificial specimen in question in having very much less Redruthite in proportion, which condition would be produced by continuing the heating in steam for a sufficient time.

Much native copper and cuprite are no doubt formed by this action of aqueous vapour: and these experiments tend to show that a very great heat is not required for the decomposition of unfused disulphide.

Mr. Readwin's letter (CHEMICAL NEWS, vol. xxxv., p. 144) opens up, I think, altogether the most interesting side of this "growth" question, viz., whether or not such formations of native gold, silver, and copper do sometimes take place spontaneously, without any application of heat, steam, or hydrogen. Mr. Readwin asserts that they *do*, and has, I believe abundant evidence to bear out his views, which he will presently, I hope, lay before us. As it is not likely that such experiences are limited to Mr. Readwin's cabinets, it is to be hoped that his fellow mineralogists who possess collections will give us the results of their observations on the subject.

Laboratory, Wallasey Ore Works,
Birkenhead, April 14, 1877.

PS. Since writing the above I have just received this week's CHEMICAL NEWS, and read the note by Mr. Collins emphatically confirming Mr. Readwin's statements, and speaking of similar phenomena as known to himself and others. So we shall soon, I hope, receive accounts of many such growths of silver, &c., whether resembling "the nose of a city arab" or otherwise. It would be interesting to know whether the filaments in these cases have the same grooves, striations, and general appearance of being formed by the union of many finer threads, as seen in those produced by heat, &c.

ON A FALL OF COLOURED HAIL AND SNOW IN WESTERN CANADA.

By Dr. A. T. MACHATTIE, F.C.S., &c.,
Lecturer on Chemistry, Glasgow.

DURING *my* residence in Canada, nine years ago, a fall of hail and snow of peculiar character occurred, and the facts seem to me worthy of being recorded.

At London, in the province of Ontario, the fall began between 8 and 9 p.m., on February 24th, 1868, and was accompanied by a violent storm of lightning and thunder, and a strong gale from the south-east. At Sarnia, in the same province, on almost the same line of latitude and more than 50 miles distant from London, similar phenomena were observed, but the fall of hail and snow did not begin till about 7 a.m., on the 25th of February. The observations in London were made by me personally; in Sarnia, by a friend.

In some places the dark-coloured shower seemed to consist of snow; in others, of hail; and my Sarnia correspondent described it as being more like "*frozen rain*" than either of the above.

One square yard of the dark hail or snow, when melted, deposited rather more than 5 grains of a dark grey (almost black) powder. This amount is equivalent to almost exactly 1 ton per square mile. I could not learn with certainty over what extent of district the shower fell, as a sudden thaw very soon removed all traces of its presence. Considering, however, that it was observed at two places 50 miles distant from one another, and at one of them (Sarnia) it was known to extend over 10 miles square, I assume that a belt 50 miles long by 10 miles broad is not a very excessive estimate of the district covered; but of course it may have been much less or much greater, and the dark matter may not have been present in uniform quantity—most probably not. The above estimate would give no less than *five hundred tons* of the dark matter, and, at any rate, there is little doubt that the quantity was large considering the source.

On examination under the microscope I found the dark substance to consist mainly of vegetable matter far advanced in decomposition. This result has since been corroborated by Dr. James Adams, of Glasgow, who further expressed the opinion that the vegetable matter consists principally of the remains of *cereals*.

From the circumstance that the surface of the ground and all shallow waters in Canada were frozen for months before the shower fell, it would appear that the dark matter could hardly have come from any local source. It is more likely that it came from some distant southern district of America, where the ground was neither frozen nor covered with snow: this, however, is mere conjecture.

It will be observed, from the above remarks, that the dark matter referred to in no way resembles the siliceous-shelled microscopic organisms which have been so often observed to fall on the Atlantic Ocean and elsewhere. It is this unusual character, as well as the quantity of the above dark shower, that induces me to draw attention to it. There was no difficulty in obtaining it *pure*, because the shower was deposited in three distinct strata:—(1.) Pure snow. (2.) The layer containing the dark substance. And (3.) A layer of pure snow when the violence of the storm had abated.

Presence of Zinc in Animals and Vegetables.—MM. G. Lechartier and F. Bellamy.—The authors first succeeded in detecting zinc in the livers of various men of different occupations and who had died of different diseases. They recognised the same metal in the muscles of an ox, in the liver of a calf, and in the eggs of the common fowl. Lastly, zinc was disdovered in wheat, maize, barley, winter tares, white Neapolitan haricots, beet-root, &c. The reagents employed were subjected to a careful examination and found free from zinc.—*Comptes Rendus.*

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 119.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

The number given on p. 119 represents the proportion of the bulk of the lead chambers, which, for an equal production of sulphuric acid, is necessarily larger for roasting pyrites than when free sulphur is burnt. Gerstenhöfer, for the escaping gases both in roasting pyrites and in burning sulphur, employs a normal amount of 6 per cent by volume of oxygen. Hence the most advantageous composition of the gases on entering, theoretically speaking, in case of sulphur is :—

Sulphurous acid	10·65 by volume
Oxygen	10·35 ,,
Nitrogen	79·00 ,,

For pyrites :—

Sulphurous acid	8·80 ,,
Oxygen	9·60 ,,
Nitrogen	81·60 ,,

The statements as to the proportion of oxygen in the gases leaving the chamber vary widely. According to R. Wagner† the escaping gases do not contain more than 2 to 3 per cent of oxygen. Scheurer-Kestner, in a private communication to A. W. Hofmann, mentions that the gases escaping from the chambers contain 6 per cent of oxygen, independent of the oxygen present in the form of nitrous acids. The varying statements may be due to the circumstance that some manufacturers use Gay-Lussac's column for absorbing the nitrous acid, whilst others work without it.

For the determination of the oxygen various apparatus have been latterly introduced, especially arranged to permit of accurate tests being executed by a common workman.

Winkler has justly pointed out‡ the great technical value of gas analyses, and has described an apparatus which he has designed for the purpose.

Max Liebig‖ has also accurately described another very serviceable apparatus for the same object.

Particularly interesting, both theoretically and practically, are the researches of R. Weber, of Berlin, on the theory of the manufacture of sulphuric acid. His first publications on this subject bear the date 1862. He§ analysed the so-called "chamber-crystals," and assigned to them the formula, $HOSO_3+NO_3SO_3$, or, according to the present notation, $HSO_4+N_2O_3SO_3$. The accuracy of this composition has been since confirmed by other chemists.¶

In subsequent memoirs Weber** enlarges on the chemical process in the chambers; he points to the action of the nitrous acid, and assumes various reactions according to the greater or smaller quantity of steam.

Kolb†† expounds the different theories on the manufacture of sulphuric acid in historical succession, and holds that Peligot has given the best explanation of the process. The last-mentioned chemist pointed out in 1844 that "chamber-crystals" were never formed during successful working. He maintained that the sulphurous acid was oxidised to sulphuric acid by the nitric acid, and represented the process in the following series of equations :—

$$NO_5+SO_2+ag = NO_4+SO_3+ag$$
$$2NO_4 \quad +ag = NO_3+NO_5+ag$$
$$3NO_3 \quad +ag = 2NO_2+NO_5+ag$$
$$NO_2+O \quad = NO_4$$

Transposed into the present notation these formulæ appear as—

$$N_2O_5+SO_2+H_2O = N_2O_4+H_2SO_4$$
$$2N_2O_4+ \quad H_2O = N_2O_3+2(HNO_3)$$
$$3N_2O_3+ \quad H_2O = 4NO+2(HNO_3)$$
$$2NO+ \quad O = N_2O_4$$

Winkler* assumes that the process of sulphuric acid making depends essentially upon the reaction between sulphurous acid and hyponitric acid in presence of steam. According to his view there is formed a compound of sulphuric acid and nitrous acid, which sinks to the bottom in the form of a white mist, often observed; comes then in contact with the hot dilute chamber acid, and is dissolved therein, when nitrous acid is liberated and oxidises a fresh dose of sulphurous acid, and is thereby converted into nitric oxide. This, in turn, seizing the free oxygen present is re-converted into hyponitric acid and commences its circulation anew.

Hasenclever, in his treatise on roasting furnaces† assumes that the reaction takes place in such a manner that sulphurous acid and nitrous acid in presence of steam form sulphuric acid and nitric oxide, which latter is then re-converted into nitrous acid by the air, thus rendering the process continuous.

Fr. Bode‡ maintains that this view of Hasenclever's transgresses the logical laws of thought, though, since, according to his formulæ, the decomposition and reformation of nitrous acid must go on simultaneously under the same conditions, and that it is, moreover, contradicted by the view of Winkler, and by known chemical laws. Here we must remark, however, that, according to Bode's view, every theory of the formation of sulphuric acid must offend against the logical laws of thought, whether we consider, with Berzelius, that it is nitrous acid, with Winkler that it is hyponitrous acid, or with Peligot that it is nitric acid, which hands over oxygen to the sulphurous acid.

It is incontestable that nitric oxide gas is repeatedly oxidised and reduced in the chambers, and, though we must certainly assume that decomposition and recomposition go on simultaneously, it does not by any means follow that they must take place under identical conditions. Molecules of steam, oxygen, nitrous acid, sulphurous acid, and sulphuric acid in an atmosphere of nitrogen traverse the chamber from end to end. According to Schwarzenberg's calculation of the percentage composition of the entering gases when working with pyrites there are 53·5 volumes of oxygen to 46·5 volumes of sulphurous acid. At the very outset of the process, therefore, there are present in the gaseous mixture more molecules of oxygen than of sulphurous acid. In the further progress of the reaction the proportion of oxygen must increase, since in the formation of sulphuric acid only 1 volume of oxygen is removed from the mixture for every 2 volumes of sulphurous acid. As soon as a molecule of nitrous acid is reduced to nitric oxide the reducing sulphurous acid disappears from its immediate vicinity, whence oxidation is at liberty to set in when the gaseous mixture enters the vacuum formed by the formation of sulphurous acid. If, then, during the further progress of the reaction, the molecules of nitrous acid and of sulphurous acid come again in contact; the formation of sulphuric acid and of nitric oxide is repeated, which latter is again transformed into nitrous acid. The oxides of nitrogen are therefore chiefly present in the chamber in the state of nitrous acid, less abundantly as nitric oxide. In fact, the faint yellowish colour of the gases in the chambers, where it can be observed by means of sky-lights and side windows (*e.g.*, in the sulphuric acid works at Nienburg) supports this view.

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† R. Wagner, *Chem. Techn.*, 9 edit., 1873, ii., 235.
‡ Winkler. *Journ. f. Pracht. Chemie*, vi., 301.
‖ Max Liebig, *Dingl. Pol. Journ.*, ccvii., 37.
§ R. Weber, *Journ. f. Prakt. Chemie*, lxxxv., 423.
¶ Rammelsberg, *Bul. Chem. Ges.*, 1872, 310.
** Weber, *Pogg. Ann.*, cxxvii., 543, and cxxx., 329.
†† Kolb in his work cited on p. 68.

* Winkler in his work cited on pp. 20, 48.
† Hasenclever, *Zeitschr. d. Ver. Deutsch. Ing.*, 1870, 706.
‡ Fr. Bode, "Beiträge zur Theorie und Praxis der Schwefelsaure," Berlin, 1872,

Hasenclever assumed nitrous acid as the oxidising agent for sulphurous acid, because, according to Weber's investigations, nitric oxide gas and oxygen in presence of hydrated sulphuric acid and even of an excess of oxygen, do not form hyponitric but nitrous acid, and because Winkler has detected sulphurous acid as predominant among the gases passing from the chambers into the Gay-Lussac tower.

So long, however, as among the various theories of the formation of sulphuric acid in the lead-chambers, successively proposed by Berzelius, Davy, de la Provostaye, Peligot, Weber, Winkler, &c., no one has been definitely established by exact experiments, we must content ourselves with the view given by Clément and Désormes* at the beginning of the century:—"Thus nitric acid is merely the instrument of the complete oxygenation of the sulphur. It is its base, nitrous gas, which takes the oxygen from the atmosphere to offer it to the sulphurous acid in a suitable state."

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

April 28th, 1877.

Professor G. C. Foster, F.R.S., President, in the Chair.

Mr. W. Ackroyd described some methods of studying selective absorption in relation to the doctrine of aggregation. After referring to the absorption of iodine vapour and iodine violet solutions, he showed that an analogy exists between these solutions and the aniline dyes, and a method was indicated by which the approximate size of the particles affecting light might be estimated.

Prof. H. McLeod exhibited several forms of apparatus which he has, in conjunction with Lieut. G. S. Clarke, R.E., arranged for determining the speed of machinery, &c., from observations made on the figures produced by combining their motion with that of a vibrating body: a description of them has already been communicated to the Royal Society. If a uniformly-moving point of light be reflected from a mirror attached to a tuning-fork vibrating in a plane at right angles to the motion of the point, the reflected image will appear as an ordinary single wave, the length of each undulation depending on the relative velocities of the fork and point of light. A double figure of the form of a series of figures-of-eight, caused by the overlapping of two waves, will be formed if a series of points of light move uniformly with such a velocity that a point passes over two intervals during an odd number of vibrations of the fork, and other more complicated forms will at once suggest themselves. If equidistant perforations be made in a circle on a disk which is attached to a rotating axis, and the number of vibrations of the fork be known, the form of figure reflected on to the screen will, theoretically, give the requisite data for determining the rate of rotation of the disc; and, further, a slight increase or decrease in this rate causes the figure slowly to move in the same or opposite direction to the disc. If the fork make 3600 vibrations, and the disc 100 revolutions per minute, the circle must be divided into 72 equal intervals, but for such a number as 101 revolutions 71·287 intervals are needed. This fact would introduce some difficulty in preparing an apparatus for measuring the velocity of rotation so as to give the speed in whole numbers per minute, but it may be obviated by ruling convergent white lines on dark paper, and so wrapping it round a cylinder that one line is parallel to the axis, an arrangement which gives every possible subdivision of a circle between any given intervals. The figures are then observed by examining these lines through a narrow slit in a light opaque screen attached to a tuning-fork or reed vibrating in a plane parallel to the axis of the cylinder. This observing apparatus is moved parallel to that axis until the figure remains stationary, when the number of rotations is read off on a graduated scale. Conversely, if the number of rotations of the cylinder is known the period of the tuning-fork can be determined. Incidentally, Prof. McLeod explained a simple method of causing a fork to vibrate, and the manner in which they have succeeded in maintaining the vibrations of a reed. The former consists in the use of a short piece of soft iron fixed on an axis between the prongs of the fork. When horizontal it slightly separates the prongs, and on being rapidly rotated through 90° it leaves them vibrating. As a reed requires a large volume of air at a low pressure it was found impossible to ensure its vibrating by the use of ordinary bellows, but if the blast from them be employed to draw air into the chamber, as in Giffard's injector, the result is perfectly satisfactory. It was found that variations in temperature influence the determinations, inasmuch as they cause the period of the fork or reed to vary. When the former is used it becomes necessary to deduct 0·011 per cent of the result for each degree centigrade of rise above the temperature for which the fork is set, and 0·0277 per cent when employing a reed.

Dr. Stone referred to the converse use of the apparatus for determining the number of vibrations of a tuning-fork, and mentioned that the difficulty in causing the reed to vibrate would be removed if a drum-head were made in one side of the box containing it.

Mr. Ellis mentioned some experiments he has made to determine the pitch of the principal tuning-forks in Europe, and especially described some experiments with Appun's tonometer.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

April 23rd, 1877.

Prof. A. W. Hofmann, F.R.S., Vice-President, in the Chair.

Prof. A. Vogel exhibited a simple method for the "*Detection of Small Quantities of Carbon Monoxide in the Air*," based upon the alteration in the spectrum of blood caused by the absorption of this gas. The spectrum of pure blood shows two sharply-defined bands between the lines D and E in the yellow field. By the absorption of CO, a slight movement of the bands in the direction of the red part of the spectrum is caused. If $(NH_4)_2S$ be added to pure blood, the spectrum displays a single band situated midway between the positions of the former pair, while no such alteration occurs in the presence of CO. In order to detect the presence of this gas in a room, a dilute aqueous solution of blood—a single drop afforded by a puncture in the finger suffices—is shaken in a test-tube with the air of the apartment, and, while held between a lamp and an ordinary pocket spectroscope, two drops of $(NH_4)_2S$ are added. The reaction is so delicate that the presence of 0·3 per cent CO in the air is sufficient to prevent the disappearance of the two bands.

Dr. A. Franck stated that, in the course of observations "*On the Disintegration of Pumice*," he had found that the rapidity of decomposition was dependent on the alkaline ingredients, and that it was three times greater in the case of potash than in that of soda. The presence of lime appeared to increase the rapidity of the removal of the alkalies.

Prof. A. W. Hofmann stated that he had published, a number of years since, the method recently described by Goldschmidt and Ciamician, of determining the specific densities of vapours by the weight of the mercury forced out from the apparatus.

Prof. C. Liebermann finds, by analytical experiment,

* Clement and Desormes, *Ann. Chim. Phys.*, lix., p. 329.

that the "*Dinitro-thymol*" obtained by him from nitroso-thymol is identical with that obtained from thymol-sulphonic aid.

E. Buckney and A. Thomsen have obtained "*Trichlor-acetic Anhydride*," $(C_2Cl_3O)_2O$, by the action of PCl_3 on trichlor-acetic acid. It is a colourless liquid, boiling at 223°, and decomposed at once by moisture.

The following communications have been received from non-resident members :—

H. Schiff, "*Reaction for Carbamid.*" If carbamid be brought in contact with furfurol and water, a characteristic bright violet colour is produced, which disappears gradually.

E. Schunck and H. Rœmer, "*Purpuroxanthic Acid.*" This substance, lately found by the authors in commercial purpurin (Chem. News, vol. xxxv., p. 82), is shown to be identical with the munjistin obtained by Stenhouse, in 1864, from the *Rubia munjista* of India. The opinion of A. Rosenstiehl, lately expressed before the French Academy, that this acid is identical with the ε-purpurin discovered by him, is opposed on ground of the too great difference in the melting-point and the analytical results.

D. Müller has carefully repeated Bastian's experiments on "*Spontaneous Generation*," and records as complete an absence of bacteria as Pasteur.

V. Merz and W. Weith communicate "*Some New Methods of obtaining the Nitriles of the Aromatic Hydrocarbons.*" These consist in (1) conducting cyanogen into boiling hydrocarbons ; (2) in exposing the monochloro- or monobromo-derivatives to the action of cyanides in sealed tubes, at 250° to 400°—a process yielding 20 per cent of the theoretical amount ; and (3) in leading the vapours of these halogen derivatives over a melted mass of sand and ferro-cyanide of potassium. The latter method yields, by distillation, a substance which—although not showing by analysis the composition of a nitrile—is oxidised into benzoic acid. The hydrocarbons form, with ClCN and BrCN, the halogen derivatives and HCN.

H. Plath, "*On Madder Colouring-Matters.*" The purpuroxanthic acid of Schunck and Rœmer is obtained from crude purpurin by suspending the latter in glacial acetic acid, adding a few drops of fuming nitric acid, and boiling. The solid matter gradually dissolves accompanied by an escape of gas, and on addition of water to the cold solution the purpuroxanthic acid is precipitated. The author's experiments show also conclusively the difference of purpurin hydrate and pseudo-purpurin. The latter is shown, by heating with water and development of CO_2, to contain a carboxyl group.

V. Griessmayer, "*On the Peptons of Malt Infusions.*" The author finds that the protein substances of beer and infusions of kiln-dried malt consist of (1) a malt pepton, distinguished from ordinary pepton by optical inactivity, indifference towards the biuret reaction, and precipitation with sodic sulphate and acetic acid ; and (2) a malt para-pepton, distinguished from ordinary para-pepton by optical inactivity and precipitation with alcohol.

E. Erlenmeyer, "*Water as an Oxidising and Reducing Agent.*" The author considers that the carbonic acid in plants, by the action of water under the influence of chlorophyll and light, undergoes a change similar to that produced by water on the hydroxyl acids of the fatty series, viz., decomposition into formic acid and hydrogen peroxide, the latter yielding the free oxygen produced by living plants.

"*Halogen Derivatives of the Fatty Acids.*" Butyric acid and caproic acid are changed completely into bromo-acids by the action of Br at 100°.

L. Meyer, "*Iodine-trichloride.*" In opposition to the late statements of Christomanos, it is shown that iodine-trichloride does not possess a constant melting-point, and that the melting is equivalent to decomposition, occurring within a great range of temperatures.

A. Emmerling, "*On Phyto-chemical Processes.*" The author has conducted a series of experiments with the view of ascertaining the peculiar process by means of which plants exert a solvent power on various insoluble constituents of the soil when brought in contact with the roots. This reaction is considered to be chiefly due to the vegetable acids, especially oxalic acid, but to be also dependent on the presence of small quantities of nitrites (which the author has previously shown are capable of being decomposed in vegetable juices by oxalic acid, under formation of free HNO_3), or possibly other soluble salts. Iceland spar was placed in an extremely dilute solution of oxalic acid, and was attacked in only the slightest degree. On the addition of minute quantities of HNO_3 or KNO_3 a comparatively rapid decomposition ensued, the nitric acid releasing the carbonic acid, and then surrendering the lime to the oxalic acid. This ability of small quantities of certain mineral salts to lend a decomposing power to oxalic acid is regarded then as explanatory of the above-mentioned phenomenon.

R. Nietzki, "*Amido-azo Compounds in the Toluen Series.*" Ortho-amido-azo-toluen, $C_{14}H_{15}N_3$, was prepared by passing a stream of nitrous acid through ortho-toluidin. It is insoluble in water, crystallises in yellow laminæ from alcohol, and melts at 100°. Diazo-amido-toluen, when brought in contact with para-toluidin salts, does not yield an amido-azo compound. With ortho-toluidin salts, however, it forms ortho-amido-para-azo-toluen, $C_7H_7.N..N.C_7H_6(NH_2)$, a body closely resembling amido-azo-benzene. With aniline salts, a similar body, amido-benzene-para-azo-toluen, $C_7H_7.N..N.C_6H_4(NH_2)$, is obtained, which crystallises in dark yellow needles with a beautiful blue reflection, and gives finely-coloured derivatives. The two amido-azo-toluens yield, with aniline salts, colouring matters, isomeric but not identical with rosaniline. The solutions of all these compounds are rendered colourless by boiling with zinc, but regain their colours by exposure to the air.

F. H. van't Hoff, "*Chloro-bromo-Carbon.*" The author obtains this compound by the action of bromine on trichlor-acetate of potassium,—

$$CCl_3.CO_2K + Br_2 = CCl_3Br + CO_2 + KBr.$$

Chlorine and iodine chloride produced small quantities of CCl_4. Iodine caused a slight formation of C_2Cl_6.

"*The Limiting Plane in the Formation of Ethers.*" Mathematical considerations on ether formation, based on Berthelot's investigations in this direction.

V. von Richter, "*On Keton Acids.*" The author has sought in vain to obtain synthetically acids identical or isomeric with pyro-racemic acid, $C_3H_4O_3$, by preparing a possible methyl keton acid, $CH_3.CO.COOH$, from monochlor-aceton, and an ethylen-oxide-carbonic acid, $COOH.(CH)(CH_2)O$, from epichlorhydrine. Equally unsuccessful has been his attempt to change pyro-racemic acid into dichloro-propionic acid by the action of PCl_5.

E. Baumann, "*On Phenol.*" The statement of Runge, the discoverer of phenol, that it does not decompose alkaline carbonates, is found to be true only at ordinary temperatures. By boiling phenol with a solution of potassic carbonate the CO_2 was set free, and potassium phenylate was formed. The formation of potassium phenyl-sulphate by the action of potassium phenylate on potassium pyro-sulphate is found to be a universal reaction for all bodies containing a phenol-hydroxyl group. The author has discovered that phenol is a constant companion of indol and several other substances resulting from the putrefaction of albuminous bodies with water and pancreas, at 40°. 100 grms. pancreas and 100 grms. fibrine yielded 0·073 grm. of tribromo-phenol.

R. Fresenius, in reply to a recent communication from H. Vohl "*On H_2S in Mineral Waters*," adduces evidence to show that in mineral springs H_2S occurs in company with free CO_2, bicarbonate of soda, and ferrous bicarbonate.

S. M. Losanitch, "*Action of Nitric Acid on Compound Ureas, Urethane, and Guanidins.*" Carbanilid, sulpho-carbanilid, dinitro-sulpho-carbanilid, and triphenyl-guani-

din, all yield by this reaction tetra-nitro-carbanilid, $CO[NHC_6H_3(NO_2)_2]_2$. Mono-sulpho-ethyl-phenyl-urethane is changed into dinitro-phenyl-ethyl-urethane.

A. Baeyer has prepared from furfur-propionic acid, by the action of Br and Ag_2O, "*Furfuronic Acid*," $C_7H_8O_5$, crystallising in colourless needles and melting at 180°. By reduction with sodium amalgam it is changed into hydro-furfuronic acid, $C_7H_{10}O_5$, a colourless, crystalline, very soluble substance.

OBITUARY.

WILLIAM GOSSAGE.

With regret we record the death of Mr. William Gossage, of Widnes, to whom we are indebted for many most important discoveries. At the early age of twelve years he was apprenticed to his uncle, a chemist and druggist, at Chesterfield. Here, by hard reading, he not only made himself acquainted with the principal chemical books of that period, but also, with the assistance of a French refugee, acquired a competent knowledge of the French language. The ardour of the teacher was not, however, equal to that of his pupil; and as he sometimes failed to be up at four o'clock in the morning for the purpose of giving a lesson, an alarum was invented by Mr. Gossage for his benefit, which subsequently became the subject of a patent. On leaving Chesterfield Mr. Gossage commenced business at Leamington, where, in addition to the druggist's shop, he entered upon the manufacture of Leamington salts. In 1830 he was appointed Chemist to the Stoke Prior Salt and Alkali Works in Worcestershire, where he remained nearly twenty years. In 1836 Mr. Gossage invented his condensing towers, which are still employed by manufacturers of salt-cake. Similar towers were also afterwards used for the oxidation of red liquors. Mr. Gossage was the first to appreciate the wasteful expenditure of manganese which took place in the old process for the production of chlorine in the manufacture of bleaching-powder; and he proposed the preparation of artificial peroxide of manganese from the waste chloride of that metal, by the addition of milk of lime, and causing the precipitate produced, while in a state of hydrate, to be strongly agitated by atmospheric air, "so as to absorb oxygen from it." In 1841 he removed to Birmingham, where he was occupied in the manufacture of white-lead by a process consisting in exposing to the action of carbonic acid gas—either pure or diluted—a mixture of oxide of lead with acetic acid, or acetate of lead with water. In 1844 Mr. Gossage commenced copper-smelting in South Wales, and devoted much attention to the recovery of sulphur from the waste gases from the ores calcined. In 1848 he returned to Stoke Prior, and two years later moved to Widnes, where he established himself as an alkali manufacturer, and erected mills for crushing the limestone employed in the neighbourhood for working Le Blanc's process. He also successfully established smelting-works for the treatment—for copper and silver—of the burnt Irish pyrites, which had been hitherto thrown away by sulphuric-acid makers as a waste product. It was here that, in 1853, he first applied his condensing towers to the oxidation of black-ash liquors by exposing them in a state of minute division to the action of atmospheric air; and in the same year he patented a process for obtaining caustic soda directly from black-ash liquors, which is now generally adopted. In 1854 Mr. Gossage turned his attention to the manufacture of soap. After experiencing many difficulties, he succeeded in producing excellent and cheap soaps from palm oil, silicate of soda, and other materials. He subsequently commenced the manufacture of blue-mottled and other descriptions of soap. In 1857 Mr. Gossage read a paper before the British Association at Manchester, "On the History of Alkali Manufacture," and in 1870 a supplementary paper on the same subject, before the same Association, at Liverpool. He was elected a Fellow of the Chemical Society in 1862, and in 1866 was placed on the Commission of the Peace for the County Palatine of Lancaster. He died in the 78th year of his age, at his residence, Earlsleigh, Bowdon, Cheshire, on the 9th of April, 1877, and was buried at Smithdown Lane Cemetery, Liverpool.

CORRESPONDENCE.

MOSS-COPPER, &c.

To the Editor of the Chemical News.

Sir,—I know of few more intently interesting subjects than the formation of minerals in relation to time. In my simplicity, perhaps, I have always thought it to be a more or less rapid proceeding, although an esteemed and talented friend in Dublin thinks exactly the reverse.

My direct object the other day in writing to you was to tickle mineral collectors a little, so that they might be induced to look up some of their neglected old acquaintances. It is very refreshing to have got an advocate in my friend Mr. Collins, especially as it appears that I gave him the germs of his silver-growth in a bit of argentite.

Touching *silver-growth*, I must say that his observed "upward" growth has been the exception to the goings-on of my own argentite specimens. Ever since I gave him (February, 1876) the specimen he refers to its relatives in my cabinet have been, perruquier-like, curling off Q.C.'s silver wigs so fast that I stand a chance presently of being deprived of this particular kind (?) of argentite altogether. These silver-growths have been very noticeable all this month, and more particularly so the last few days. My other authentic specimens of argentite show, as yet, no such sportive characteristics.

Touching *Copper-growth*, allow me to say that during last week from the bulk of the moss-copper—referred to in my last, and just afterwards pressed down into a glass-topped box—five copper filaments reached the under surface of the glass. Elasticity, I fancy, had little or nothing to do with these remarkable movements.

The long *grey* filament in another box, before mentioned, has increased visibly in terminal thickness, and has bent low down, as if through additional weight. The shorter (younger) *red* filament, also referred to, has now reached the top of the same box by an up-growth of nearly half an inch. Perhaps, as in child-growth, it may be that periods of mineral growth alternate as to states of width and length. In any case the facts are interestingly recreative, if unimportant.

Touching *gold-growth*, I wish to say that last year, about this time, I discarded several hundreds of gold-stones from my collection. I gave away a good many to persons luxuriating in mineral-love. The rest I wrapped up in bits of newspaper, and put into a box out of my way. To day I overhauled the contents of this box, and to my delight found that out of 181 of the despised specimens 72 of them are now of appreciable interest!

Many of the gold-growths on these stones are so palpable to unaided sight that it is simply impossible that they could have escaped my eye, and my sense too, if there, when I put them away as comparatively worthless. I should add that nearly all these stones were found by me in the same locality since 1862, and that the gold (electrum), taking an average of more than 100 assays of the gold from the same place, contains from 15 to 20 per cent of fine silver!

Many of the growths proceed from iron sulphide (marcasite), along with copperas crystals (melanterite?). Some are associated with tellurium-bismuth crystals (tetradymite); others proceed from quartz, apparently pure, or

slightly iron-stained (?). Perhaps those friends to whom I gave gold specimens last year and the year before will oblige by examining them and reporting thereon.

If more weighty evidence is needed than "mere cabinet specimens" in proof of gold-growth, allow me to add that I have just put under a water-tap an almost forgotten mass of irregular white quartz crystals, weighing (by guess) half a hundredweight or more. This big stone, on "showing specks of gold," was taken out of a mountain-wall in Merionethshire in 1862 or 1863. It has been in my possession ever since; always, somehow, in the way; kicked against very often, and as often at the disposition of anybody for the taking. But "things change their titles as our manners turn." It is no more to be unnoticed upon a floor. It now shows a number of very beautiful leaf-like and other silver-gold growths, and must be henceforth duly respected under a glass case. A rare find this in my favour. Mr. Collins will recollect, perhaps, seeing it last year, when it was only "specked with gold." I wish he could see it now. Every atom of his unbelief as to gold-growth (if any remain) would evaporate very quickly. "I s'pects I grow'd," said Topsy. I suspect that gold grows too; for "increased bulk and weight," by this discovery, have now been amply proved beyond all further questioning.

The extreme limit, as to time, of this electrum-growth is a year or thereabouts. My belief is that the proceeding was a very rapid one. Why not? Moss copper and argentite show rapid growth. Chemists witness rapid crystallisation very commonly. Without anticipating my promised communication on mineral-growths as I have myself observed them, I will add another heavy fact which I have also noticed to day. A lump of amorphous quartz, weighing (by guess) 20 to 25 lbs., neglected, as its companion lump above mentioned. This lump when I got it in 1862, and when I last looked at it in 1876, had hundreds of specks of gold upon it. Upon washing it just now I discovered to my surprise that at least half of the specks had disappeared by dropping off; but, by way of compensation, upon this stone, also, there is now a crop of beautiful silver-gold growths, thus making it very far more interesting than it was before. (*Query*. Would electrum-coin sprout in any such way in hard times?)—I am, &c.,

T. A. READWIN.

Tuebrook, Liverpool, April 10, 1877.

BLOWPIPE TESTS FOR BORIC ACID.

To the Editor of the Chemical News.

SIR,—Dr. Foster has drawn my attention to a letter in the CHEMICAL NEWS (vol. xxxv., page 143) in the following terms:—"Hutchings writes to the CHEMICAL NEWS that your test for boric acid is useless." On referring to this letter, however, I find that Mr. Hutchings has neither treated me so discourteously, nor the subject so dogmatically, as the above expression implies, and I would therefore ask the favour of some of your valuable space to reply to his remarks.

In the first place, it must be remembered that my proposed test for boric acid is only recommended ("Pyrology," page 191) as a *pis aller*, in these words—"The following method is not so pretty or effective as that invented by the late Dr. Turner;" and, in fact, I brought it forward chiefly on account of the difficulty a travelling pyrologist might experience in obtaining potassium acid sulphate in "the jungle," whereas "blue vitriol" is common in most bazaars.

After reading Mr. Hutchings's letter I repeated my experiments, which are given below in detail, and I think the reason Mr. Hutchings has failed to obtain satisfactory results is the *deficiency of heat* employed by him, while I have nowhere recommended the use of a Bunsen burner. The mass made on thic kplatinum wire should be held *square* against the point of the blue pyrocone till *nearly white hot*, and then gently moved up against the blast. There should be two rings on the wire in order to hold two assays for the purpose of comparison, one supporting a substance containing boric acid, as black *tourmaline*.

(1.) Made a paste with copper sulphate solution and eggshell powder, and heated as above directed: there was a greenish tinge to the orange flame, which I got rid of by moistening the paste with a little soda dissolved in water.

(2.) Ground up mass (1) on an agate slab with a drop of water and some powdered *zoisite*, and heated as above directed: only an orange flame.

(3.) Ground up mass (2) with some powdered *tourmaline* and a drop of water, treating it afterwards as above directed. The surface of the assay fused, and a bluish green colour made its appearance in the flame, faint at first, but increasing in depth proportionately with the increase of temperature and duration of treatment.

I quite admit that the test is far from satisfactory, especially as the operator *begins* with a green flame, caused apparently by the reduction of the copper sulphate on the platinum wire, which should be kept scrupulously covered by the paste; but I altogether deny that it is "useless," and I shall be happy to show that it is not so to Dr. Foster or Mr. Hutchings, if either of those gentlemen will do me the favour to call and witness my experiments. I have devised, however, a far more reliable test for small proportions of boric acid, and one, moreover, with quantitative results, having nothing to do with the colour of the flame, but I am not at liberty to mention this at present, as it forms one of a series of papers on pyrological quantitative analysis in course of preparation for the Royal Society.—I am, &c.,

W. A. ROSS.

London, April 28, 1877.

SEPARATING NICKEL FROM ORES CONTAINING IRON.

To the Editor of the Chemical News.

SIR,—Considerable difficulty having been met with in separating nickel from ores containing a large quantity of iron, the following method was adopted:—The ore was dissolved in aqua regia, the silica separated; to the filtrate ammonia was added in excess, the precipitate of oxide of iron well stirred, filtered, and washed with ammoniacal water; the iron re-dissolved with hydrochloric acid, re-precipitated with excess of ammonia, and treated as before. The two solutions were added together, and boiled to expel excess of ammonia; solution of potassa hydrate was then added, and the solution heated till ammonia was no longer given off, the solution filtered, the precipitate well washed with hot water, re-dissolved in acid and re-precipitated by potash, washed, dried, ignited, and weighed in the usual manner. Care must be taken that no copper is present during the operation. By this method better results were obtained than by the usual way.—I am, &c.

A. THOMAS, F.C.S.

Adelaide, South Australia.

Royal Institution of Great Britain.—At the Annual Meeting on the 1st inst. the Report of the Committee of Visitors for the year 1876, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. The real and funded property now amounts to above £84,000 entirely derived from the contributions and Donations of the Members. Seventy-two new Members paid their admission fees in 1876. Sixty-three lectures and nineteen evening Discourses were delivered in 1876. The books and pamphlets presented in 1876 amounted to about 164 volumes, making, with those purchased by the Managers, a total of 394 volumes added to the Library in the year, exclusive of periodicals. Thanks were voted to the President, Treasurer, and Secretary, to the Committees of Managers and Visitors, and to the Professors, for their services to the Institution during the past year. The Officers for the ensuing year were elected.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 15, April 9, 1877.

Some of the Fundamental Data of Thermo-Chemistry.—M. Berthelot.—A re-determination of the heat of formation of sulphurous acid and of the compounds formed by bromine and iodine both with hydrogen and oxygen.

Substitution of Chlorophyl for the Salts of Copper Ordinarily Employed in the Preparation and Presevation of Green Fruits and Vegetables.—M. A. Guillemare.—The use of copper salts in the preservation of fruits and vegetables by the "Appert" process is here spoken of as perfectly legitimate, but chlorophy is recommended as an improvement.

New Method of Manufacturing Sulphides, Carbonates, and Alkaline Sulpho-carbonates.—M. C. Vincent.—If we dissolve an equivalent of sulphate of potassa in boiling water and gradually drop into it, whilst continually stirring, sulphide of barium in quantity sufficient to furnish an equivalent of real sulphide we obtain a solution containing an equivalent of sulphide of potassium, whilst the sulphate of baryta formed is precipitated and may be removed by filtration. If the quantities are correctly proportioned neither sulphide of barium nor sulphate of potassa remains in solution. If we take the liquid thus obtained in place of water to dissolve a fresh quantity of sulphate of potassa, we may thus by a new addition of sulphide of potassium obtain a more concentrated solution of potassium sulphide. This solution, if treated with carbonic acid, yields carbonate of potassa, which remains in solution, while the sulphur is evolved in the state of sulphuretted hydrogen. If the solution of sulphide of potassium is agitated in a closed vessel with bisulphide of carbon, and heated to about 50° sulpho-carbonate is obtained containing 15 per cent of bisulphide of carbon.

Modification to be Introduced into the Use of Electricity in the Production of Galvanic Deposits and of Chemical Decompositions.—M. Arn. Thenard.—All who are acquainted with electro-magnetic machines know that the maximum of effect produced corresponds with the moment where the current is best closed, and the minimum with that when it is most open. The author was led to think that electrolysis might derive advantage from this principle. Hitherto, when desirous of effecting a metallic deposition or a chemical decomposition a single bath has been used, into which were plunged two anodes more or less closely approximating. That is to say we have placed ourselves in conditions approaching those of the least electric resistance and the maximum of effort. The author has therefore multiplied the baths, taking care to connect their anodes as is done with the elements of a battery arranged for tension. The result was that the totality of metal deposited increased with the number of baths.

New Method for Establishing the Volume-Equivalent of Vapourisable Substances.—M. L. Troost.—The author finds, in opposition to the view of Naumann, that hydrate of chloral may exist in the state of vapour at 78° and at 100°, and that consequently its volume-equivalent corresponds to 8 volumes.

Oxidation of Metallic Sulphides.—MM. Ph. de Clermont and H. Guiot.—The authors have studied metallic sulphides to ascertain if others beside the sulphide of manganese are liable to violent oxidation if compressed and powdered whilst still moist. With ferrous sulphide a rise of temperature was experienced, and with sulphide of nickel the heat increased from 15° to 60°. With the sulphides of cobalt, copper, and zinc the oxidation is not rapid enough to give rise to the evolution of heat.

Decomposition of Organic Liquids by the Electric Spark with the Production of Fundamental Carbides of Hydrogen.—M. P. Truchot.—The author has obtained acetylen, ethylen, and formen, the latter probably mixed with a certain quantity of hydride of methylen.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 39, March, 1877.

Presence of Selenium in Refined Silver.—M. H. Debray.—It has often been found that ingots of silver of 80 high a standard of purity as 998 to 990-1000ths are very ill suited for the preparation of industrial alloys. The bad quality of this silver appears most striking in the alloy 950-1000th (first standard). The bars or plates are blistery, and when worked they display surfaces covered with greyish points which do not readily disappear on polishing, and which always reappear under the gilding. During the fusion of the metals silver and copper, which form the alloy, a brisk ebullition is produced with projection of particles, even when working, as is customary, under a stratum of carbon. These peculiarities are due not to sulphur, of which not a trace is present, but to selenium. To detect this body in the silver we dissolve 100 grms. in hot nitric acid, at 34° Baumé. The trace of gold present remains in the form of very dense blackish flocks, which are separated from the solution. This latter is then precipitated with hydrochloric acid and evaporated to dryness, and, without too much heating the acid liquid, it is clarified or filtered. The selenium is then found in the residue as selenic acid. It is boiled with a few drops of hydrochloric acid to convert it into selenious acid, and we add to the liquid thus obtained a solution of sulphurous acid which—especially in heat—reduces the selenious acid, and gives a black deposit of selenium, easily recognised. The source of the selenium is in the sulphuric acid used by the refiners in separating gold from the triple alloy of gold, silver, and copper. It is therefore very important to reject samples of acid containing this impurity. To detect the presence of selenium in sulphuric acid it is diluted with four times its volume of water, and a concentrated solution of sulphurous acid is added to the clear decanted liquid. The mixture is then heated to 80°, when a precipitate of finely divided selenium appears, generally red.

Potash Industry.—H. Gruneberg.—An account of the manufacture of potash from beet-root treacle, from the suint of wool, and from the Stassfurt salts.

Les Mondes, Revue Hebdomadaire des Sciences, No. 15, April 12, 1877.

Sideraphthite is the name given to a new alloy composed of 66 parts of iron, 23 of nickel, 4 of tungsten, 5 of aluminium, and 5 of copper. It is said to resist sulphuretted hydrogen and the vegetable acids, and to be but slightly attacked by mineral acids. It is really more useful than silver, and can be prepared at less cost than German silver.

Resin as a Source of Light.—M. Guillemare has recently exhibited lamps fed with a resin oil, which gave a beautiful light and produced neither smoke nor smell. The oil will not burn if a burning match is thrust into it.

NOTES AND QUERIES.

Boiler Incrustation.—I should be much obliged if you or any of your readers can give me information respecting "De-Haens Process" for prevention of incrustation in boilers by use of barium chloride, and more especially as to when it was first introduced and came before the public.—T. A.

THE CHEMICAL NEWS.

Vol. XXXV. No. 911.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A W. HOFMANN.

(Continued from p. 184.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

Weber has also made interesting observations on the loss of nitre. He showed that losses of nitric acid might ensue not merely from the escape of nitric oxide and nitrous acid, but that in presence of an excess of water nitrous acid is readily reduced by sulphurous acid to nitrous oxide. Fremy† also found that in the gases entering the chambers nitrous acid may be reduced to nitrous oxide, and even to free nitrogen if the sulphurous acid is too hot and too concentrated. Kuhlmann reported on this subject to the jury of the Vienna Exhibition, and writes, at length, to Dr. Hofmann as follows :—‡

"In the manufacture of sulphuric acid the behaviour of nitric oxide has been the subject of much investigation, but some points are still unexplained. The two following questions require an answer :—

"1. In what circumstances is nitric oxide converted into nitrous oxide?

"2. Is such nitrous oxide the sole product which can be formed on the reduction of nitric oxide by sulphurous acid?

"In order to solve these questions it seemed advisable not to study the reactions in the chamber, but to submit the action of sulphurous acid upon nitric oxide in the absence of air to an accurate investigation. The two gases always act more or less upon each other, the sulphurous acid becoming oxidised to sulphuric acid by the oxygen of the nitric oxide. In order to ascertain how far this deoxidation of the nitric oxide can be carried, platinum sponge was introduced, which greatly facilitates the reaction between gaseous bodies. Nitric oxide may be in this manner reduced to nitrogen with formation of a corresponding quantity of sulphuric acid :—

$$SO_2 + NO = SO_3 + N.$$

"Even without platinum sponge this reaction takes place, though incompletely. Even at ordinary temperatures some sulphuric acid is formed, and the more the heat rises the more energetic becomes the mutual reaction of the gases. It is possible that before the complete reduction of nitric oxide to nitrogen nitrous oxide may be formed in the first place, but it is essential to note that the reduction does not come to a standstill with the formation of nitrous oxide. If sulphurous acid is brought in contact with nitric oxide at an elevated temperature a complete reduction to nitrogen occurs. In these transformations the temperature plays an important part. In sulphuric acid works care must be taken that the gases do not act upon each other at too high a temperature, and the decomposition of nitre in the hot gases of the kilns must be absolutely condemned. If Glover towers are used for concentrating the chamber acid, they must be supplied with an acid as free as possible from nitrous acid; otherwise conditions are produced resembling those of the nitre decomposition just mentioned, where the reduction goes too far."

In fact the loss of nitre, with a complete absorption of the nitrous acid, in the Gay-Lussac tower lead us to suspect that under certain circumstances reduction to nitrous oxide or nitrogen must take place. For the practical utilisation of the experience collected in the laboratory it will still be necessary to ascertain at what degree of condensation of the gases, and at what temperature the above-mentioned reduction ensues. Kuhlmann's observations may hold good in many cases, but they are not universally valid, since, according to the author's experience, some works consume a minimum of nitre, although the decomposition is conducted in the sulphur kilns and in the flues leading from the pyrites furnaces to the chambers.

P. W. Hofmann* communicated to the German Chemical Society that if sulphurous acid is conducted into sulphuric acid, saturated with nitric acid, and of the sp. gr. 1·7, the nitric acid is reduced to compounds which combine with the concentrated sulphuric acid present to form the so-called chamber crystals, without the production of appreciable quantities of nitrous oxide. A different behaviour was observed if the acid saturated with nitric acid has, *e.g.*, the sp. gr. 1·5, instead of 1·7. In this case the sulphurous acid attacks the nitric acid more profoundly, and there is formed a not unimportant quantity of nitrogen, or—which for the sulphuric acid maker is practically the same thing—of nitrous oxide. The explanation must doubtless be sought in the fact that in the latter case no concentrated sulphuric acid is present with which the higher oxides of nitrogen might unite to form chamber crystals. These facts having been established he sought to turn them to account in the manufacture of sulphuric acid as follows :—

In the first chamber he diminished the jet of steam in such a manner that only acid of sp. gr. 1·7 was produced, and he found the laboratory experiments confirmed in such a manner that a much smaller quantity of nitric acid was needful for an equal amount of sulphuric acid. If the precaution is observed that whenever the sp. gr. of the chamber acid incidentally falls, it is raised again to 1·7 by the addition of monohydrated acid, a reduction of the consumption of nitric acid is effected to the extent of 1 kilo. per 100 kilos. sulphur.

(To be continued.)

ON THE RELATIVE COMPOSITION OF ULEXITE AND FRANKLANDITE.

By Prof. HOW,
King's College, Windsor, Nova Scotia.

In the *Philosophical Magazine* for April (p. 286) Prof. J. Emerson Reynolds describes a new mineral borate, found with ulexite at Tarapaca, Peru, which he names Franklandite. I wish to point out that, in comparing the composition of the two minerals, the author has adopted the wrong formula for ulexite. In the Chemical News (vol. xv., p. 192) I showed that the formula for ulexite (then called natroborocalcite, &c.), originally proposed by myself, but subsequently erroneously termed "Kraut's," was the correct expression of the composition of the mineral. This formula, changed to the new notation, is—

$$Na_2O,2CaO,5B_2O_3,15H_2O,$$

and it came to be designated by the name of Kraut because this chemist preferred it to others, and among them doubtless to Rammelsberg's—

$$Na_2O,2CaO,6B_2O_3,18H_2O,$$

on account of its general validity, upon comparison of the

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Fremy, *Comptes Rendus*, lxx., 61.

‡ Private communication.

* P. W. Hofmann, *Ber. Chem. Gesell.*, 1870, 5.

numerous analyses published, especially of the Peruvian mineral "Tiza," &c. This formula of Rammelsberg's was particularly shown by Dr. Lunge not to agree so well as "Kraut's," even with its author's own analysis; and another mineral like ulexite appears to exist in the same deposit, having closely similar composition, as indicated by the same writer (CHEM. NEWS, vol. xv., p. 86); but, as I mentioned in "Contributions to Mineralogy of Nova Scotia," iii. and v., (*Phil. Mag.*, January, 1868, and April, 1870), the mineral now known as ulexite occurs here in comparatively simple conditions, affording purer material for analysis than the mixture of salts frequently examined from Peru, and hence, no doubt, the correctness of my ormula.

Now, on comparing ulexite and Franklandite, Professor Emerson Reynolds gives, as the empirical formula of the latter,—

$$2Na_2O,2CaO,6B_2O_3,15H_2O,$$

which differs from mine for ulexite, above, by having in excess—

$$Na_2O.2B_2O_3;$$

but he takes as the formula of ulexite that advanced by Rammelsberg, just mentioned as specially shown by Lunge to be incorrect.

It follows that my formula, being almost universally received as correct for ulexite (whatever the other minerals found with this may be), the difference between this mineral and Franklandite is not, as Prof. Emerson Reynolds gives it, "that the substitution of one molecule of sodic oxide (Na_2O) for three molecules of water is capable of converting ulexite into Franklandite, as far as composition is concerned," but that the latter differs from the former by containing one molecule of sodium metaborate ($Na_2O.B_2O_3$) in addition.

April 21, 1877.

THE ACTION OF ORGANIC ACIDS UPON MINERAL SUBSTANCES.

By B. J. GROSJEAN.

THE description of his interesting experiments by Mr. H. C. Bolton (p. 114), induces me to state some of my own observations on the same subject.

Some time ago it struck me that the neutralising power of alkalies and alkaline earths might be advantageously determined by using a known weight of dry tartaric or citric acid instead of a measured volume of standard sulphuric or hydrochloric acid solution. The dry acid can be easily carried about in a small compass, and a novice in quantitative chemistry might be trusted to weigh out dry acid, whereas he would be more likely to fail in using and preserving a liquid standard acid. My experiments brought to light one important point, viz., that a weak solution of tartaric acid acts better than a strong solution *of the same weight of acid* upon calcium carbonate. I boiled 0·5 grm. of pure precipitated calcium carbonate in 10 c.c. of water; 2 grms. of tartaric acid were then added and the boiling continued. The above acid is more than two and a half times the equivalent of the calcium carbonate. But little action took place, even when I added an additional 2 grms. of acid. I then evaporated the mixture to a syrup, but the insoluble portion was actually increased instead of lessened. It then struck me that more *water* was needed, in order to dissolve the calcium tartrate. I therefore diluted the syrup to 150 c.c. and boiled, the result being perfect solution, and the loss of acidity was in accordance with theory. I then repeated the experiment with only 2 grms. of acid and added the water by degrees, boiling after each addition, the last portions added being 20 c.c. each. The insoluble matter diminished in amount after each addition of water, the diminution being accompanied by a fresh evolution of carbonic acid. I was obliged to add a total of 230 c.c. for perfect solution. It will be seen that this is 80 c.c. more than in the first experiment, the reason being that, in the first experiment I had twice as much acid present as in the second experiment. As I shall presently show, a strong solution of a large excess of acid will act better than a weak solution of a small excess, although, as pointed out above, a weak solution is better than a strong solution of the *same weight* of acid.

I next tried the experiment with 0·5 grm. of soft whiting, and with exactly the same result.

I then thought that if the acid were added to the carbonate in the form of ready made solution the result might be different. 0·5 grm. of carbonate was boiled with 10 c.c. of a 20 per cent solution of the acid, but, as before, an insoluble residue was left, which required much water for solution. To prove that the insoluble matter was carbonate coated with tartrate I washed away all the acid and treated the residue with hydrochloric acid. Carbonic acid was at once given off and the residue dissolved. The coating of tartrate was not removed by grinding the wet residue in a mortar for some minutes and again boiling with the acid.

When the 0·5 grm. carbonate is added to the solution of 2 grms. of acid in 10 c.c. in small portions at a time, the mixture being kept at the boil, an insoluble tartrate is also produced; but it is almost entirely free from carbonate, and, with great care, might perhaps be obtained quite free.

My last and most striking experiment was with a large excess of acid. 0·5 grm. of carbonate was treated with 10 c.c. of a *saturated* solution of tartaric acid. But little action took place *in the cold*, even after waiting a considerable time, and adding another 10 c.c. of acid. But when the 10 c.c. was previously diluted with 250 c.c. of water, everything was dissolved in *one minute* in the cold. In the former of these two mixtures the carbonate dissolved at once on boiling, the strong solution of this large excess being therefore a better solvent than a solution of only 2 grms. in much water, provided the water in the latter case is less than 230 c.c. (see above, expt. 2). But, as shown above, in the experiment with *cold* acid, the large excess of acid acts still better when largely diluted.

The practical rule, then, to ensure solution of calcium carbonate in tartaric acid, is to use either a large excess of hot acid or plenty of water. No doubt Mr. Bolton's idea of discriminating minerals by the way they behave with organic acids might be still further extended to the use of acids of various strengths and in different degrees of excess.

J. B. Lawes's Citric and Tartaric Acid Factory,
Millwall, E.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 3, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors, the minutes of the previous meeting were read and confirmed. A list of presents made to the library was then read by the SECRETARY.

The following certificates were read for the first time;—J. Gardner, J. Napier, C. G. Neison, Beeby Thompson, and W. Webster, jun.

Notice was given by the PRESIDENT that he had received a requisition, duly signed, to call an Extraordinary General Meeting, and it accordingly gave him great pleasure to do so. The date of the meeting was, however, not stated.

The Treasurer, Dr. RUSSELL, then announced that he

had received £1000, free of legacy duty, from the son of their late fellow, Mr. LAMBERT, which he had placed to the general credit of the Society.

The PRESIDENT then called on Mr. J. W. THOMAS to read a paper "*On some Points in Gas Analysis*." The author, during the examination of the gases occluded in Bovey lignite, found, after removing the carbonic acid, an absorption of 1·3 to 3·8 per cent by pyrogallic acid and potash. As no oxygen was present he proceeded to investigate the cause of this absorption. He found that pyrogallic acid does not liberate carbonic acid from the alkaline carbonates; moreover, oxygen is completely absorbed, though slowly, by a solution of pyrogallic acid and potassic carbonate, provided an excess of the acid is not present. Oxygen is absorbed completely and rapidly by caustic potash and pyrogallic acid in the presence of potassic carbonate, if an excess of caustic potash be present. The author next investigates the formation of carbonic oxide during the process of absorption, and finds that the error caused thereby can be reduced to less than 0·5 per cent by using at least twice as much caustic potash as pyrogallic acid, and agitating the tube so as to hasten the absorption. Nitric oxide is absorbed by a solution of pyrogallic acid and caustic potash: the absorption is, however, not complete, owing to the formation of some nitrous oxide, the reaction being probably—

$$N_2O_2 - ON_2 + O.$$

Nitric oxide is slowly absorbed by pyrogallic acid and potassic carbonate. Of course nitric oxide and oxygen could not coexist in a gaseous mixture; but if only a small quantity (say 3 per cent) of nitric oxide be present, it is difficult to determine whether the gas is oxygen or nitric oxide, as both would be absorbed by pyrogallic acid and potash. The author therefore always adopts the method of adding a known volume of oxygen to the mixture to be analysed after absorbing the carbonic acid with potash: any decrease of volume will be due to the presence of nitric oxide. In conclusion he gives the following precautions:—An excess of caustic potash should always be preseut, and the absorption accelerated by agitation; the alkaline solution of pyrogallate should be used in moderate excess, so as to increase the rapidity of absorption and prevent the formation of carbonic oxide. The absorption should be complete in five to ten minutes. The best liquid is a saturatedsolution of caustic potash and one part of pyrogallic acid to five parts of water.

The next paper was by Dr. RUSSELL and Mr. W. LAPRAIK, on "*Experiments on the Decomposition of Nitric Oxide by Pyrogallate of Potash*." The nitric oxide was prepared by the action of sulphuric acid on nitrate of potash and ferrous sulphate. Its purity was always tested by its total absorption in a solution of ferrous sulphate. Different volumes of gas were exposed to the action of pyrogallate of potash: it was found that 58 to 59 per cent of the gas was absorbed. The authors then tried the action of pyrogallate of potash fully saturated with oxygen: in this case 76 per cent of the nitric oxide was absorbed. The action of potash alone was now investigated; 75 to 77 per cent of gas was slowly absorbed. The action was substantially the same in the cold and when heated, either at the ordinary pressure or in sealed tubes. The residual gas consisted, roughly, of 90 per cent nitrous oxide, 2 per cent nitric oxide, 8 per cent nitrogen. The action of water alone in sealed tubes, heated in a water-bath for a fortnight and remaining unopened four months, set up the same decomposition; but it was not complete, and more nitrogen was formed. Pyrogallic acid alone has no action on either nitric or nitrous oxide, and alkaline pyrogallate has no action on nitrous oxide. The authors conclude by stating that the probable action of the alkaline pyrogallate is to convert the nitric oxide into half its volume of nitrous oxide, but that simultaneously another more obscure action occurs, either from the excess of potash or from certain compounds formed by the action of the oxygen on the pyrogallate. Practically, in the gases obtained by burning a water residue, a contraction of volume on introducing alkaline pyrogallate does not prove the presence of oxygen.

MR. THOMAS remarked that, by using caustic potash absolutely free from carbonate, he had succeeded in obtaining the theoretical quantity 50 per cent of nitrous oxide, but if old alkaline pyrogallate was used a larger quantity of gas was absorbed.

Dr. RUSSELL, in reply to Mr. NEISON, said the nitric oxide used was always tested to see whether it was completely absorbed by a solution of ferrous sulphate.

Dr. ARMSTRONG was inclined to think that the reaction was not a case of simple deoxidation, but that the potassic hydrate played some part in the decomposition.

After the thanks of the Society had been returned to the authors of the above papers, Mr. GROVES read a paper, by Dr. STENHOUSE and himself, entitled "*Contributions to the History of the Naphthalen Series. No. I. —Nitroso-β-Naphthol.*" After attempting to prepare this substance by Fuch's process (*Dent. Chem. Ges. Ber.*, vol. viii., pp. 625 and 1026), with results far from satisfactory, the authors devised the following process, which yielded good results:—1 part of pure β-naphthol was dissolved in 10 parts of boiling water, by means of 1 part by measure of caustic soda, sp. gr. 1·323; cooled, and poured into 100 parts of water. This solution was mixed intimately with a liquid containing 2 parts by weight of 15 per cent nitrosyl-sulphate solution in 200 parts of water. After standing twelve to twenty hours the precipitate of crude nitroso-β-naphthol was collected on a linen filter and washed with cold water. This was purified, in the first instance, by solution in 200 times its weight of light petroleum, at 40°, filtering, and precipitating with an alcoholic solution of ammonia: this method of purification was unsatisfactory. No evidence could be obtained of the existence of a second isomeric nitroso-compound. Other solvents were equally useless for purifying the crude product. The authors finally obtained the body pure by precipitation as a barium compound from a solution in dilute alkali: this compound, after decomposition with an excess of hydrochloric acid, and washing, was re-dissolved, re-precipitated, &c., a second and third time; finally, the nitroso-β-naphthol was obtained pure. The yield of pure substance is about half the weight of the naphthol originally taken. Full details (attention to which is necessary to secure success) of the preparation and purification are given by the authors. Analysis indicated the formula $C_{10}H_6(NO).OH$. The hydrated substance crystallises in minute, brilliant, yellow needles, which lose water at a gentle heat, and become brown. The anhydrous compound obtained by crystallisation from alcohol, &c., forms thin orange-brown plates or short thick prisms, melting at 109·5°. Nitroso-β-naphthol is slightly soluble in water; easily in carbon disulphide, benzene, ether, acetic acid, and hot alcohol; and sparingly soluble in light petroleum. It dissolves in cold, concentrated, sulphuric acid without alteration, but is decomposed by heating with concentrated nitric acid, and it forms green compounds with the alkalies and alkaline earths. By treating nitroso-β-naphthol carefully with dilute nitric acid mono-nitro-β-naphtho is prepared as a pale yellow crystalline powder, or in orange-brown anhydrous plates: it melts at 96°. Other compounds are formed by the action of nitric acid on nitroso-β-naphthol, which the authors have not yet completely investigated. By treating the barium compound of nitroso-β-naphthol, suspended in dilute ammonia, with hydrogen sulphide, for an hour, an amido-compound was formed: on dissolving this body in dilute sulphuric acid, and pouring the liquid into a 10 per cent solution of potassium dichromate, β-naphthaquinon separated in bright orange needles, melting at 96° C. Analysis gave the formula $C_{10}H_6O_2$. By treating this new substance with hydriodic acid a hydroquinon was prepared; on boiling with nitric acid it is oxidised into phthalic acid. The authors point

out that this is the first instance of two isomeric quinons (α-naphthaquinon, which is readily volatile, having already been prepared by Groves) derived from the same hydrocarbon.

After a few remarks by Dr. ARMSTRONG, on the constitution of the above substances, the following paper was read:—*On Asbestos Cardboard, and its Uses in the Laboratory*," by W. N. HARTLEY. This substance, specimens of which were exhibited about three-sixteenths to one-eighth of an inch thick, resembles greyish cardboard, but has a soapy feel, like steatite; it can be used for making crucible-supports, sand-baths, muffles, retort-supports, &c.; it can be cut with cork-borers or scissors; by moistening with water it can be moulded to any shape. After moistening it should be gradually dried and ignited, to get rid of organic matter. It stands the ordinary wear and tear of the laboratory well. It is formed principally of asbestos fibres.

Mr. HARTLEY, in reply to various questions, stated it could be obtained from the manufactory, 31, St. Vincent Place, Glasgow, at 4s. a pound.

After a vote of thanks to Mr. Hartley for bringing this substance to the notice of the Fellows, the Society adjourned to May 17th, when the following papers will be read:—M. M. P. Muir and S. Suguira, "On a Slight Modification of Hofmann's Vapour-Density Apparatus;" J. W. Mallet, "Note on the Fluid contained in a Cavity in Fluorspar;" J. B. Hannay, "Examination of Substances by the Time Method;" W. Ramsay, "On the Dehydration of Hydrates;" M. M. P. Muir, "On certain Bismuth Compounds," Part VI.; J. Philippson, "Theory of the Luminous and Non-Luminous Flame."

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 20, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

"*On the Action of Sea-Water upon Lead and Copper*" by WILLIAM H. WATSON, F.C.S., communicated by Dr. R. ANGUS SMITH, F.R.S.

While numerous experiments have been made and published from time to time as to the action of distilled water and various saline solutions upon lead and copper, so far as I know very few have been published as to the action of *sea-water* upon them, hence my concluding to record the following:—

The only published researches I have been able to find bearing upon this question are those by Dr. Crace-Calvert and R. Johnson, "On the Action of Sea-Water upon Certain Metals and Alloys (*Proc. Manchester Lit. and Phil. Soc.*), and later those by Kaiser, "On the Action of Sea-Water on Lead" (*Arch. Pharm.* (3), vi., 405), from which he says that after exposing strips of lead to sea-water for four days no lead could be detected in the water. He, however, does not mention the quantity of metal or the quantity of water used in the experiment, neither does he mention the method of testing.

The experiments of Calvert and Johnson were conducted as follows:—20 square centimetres of each metal, cleaned with great care, were taken and placed in separate glass vessels, immersed in equal volumes of sea-water. After one month the plates were taken out, and any compounds that had adhered to the surface carefully removed; the plates were then dried and re-weighed—*the loss being estimated and taken as the quantity of lead dissolved.* To render the results obtained of more practical value, calculations were made, and the following table constructed by them, showing the amount of each metal dissolved by 100 litres of sea-water by acting upon one square metre of each metal:—

	Grammes.
Steel	29·16
Iron	27·37
Copper (best selected)	12·96
„ (rough cake)	13·85
Zinc	5·60
Galvanised iron	1·12
Block tin	1·45
Stream tin	1·45
Lead (virgin)	trace
„ (common)	trace

With regard to these experiments we notice that the method adopted for the determination of the amount of metal dissolved was faulty—one by which small quantities could not be with certainty detected. This fact, although taking from the results some of their scientific value, does not deprive them of much practical interest.

The colorimetric method, based upon the depth of colour produced with lead or copper on addition of ammonium sulphide, being capable of detecting exceedingly minute quantities of these metals in solution, was that adopted in the experiments about to be described, so that I am able to speak of the minute variations in the quantity of metal dissolved according to the length of time during which it was exposed to the water, and the results of my experiments show that the action of sea-water upon lead and copper is exerted chiefly during the first few days of exposure, also—which appeared at first somewhat remarkable—that the quantity of metal in solution, after reaching its maximum, decreases when the metal is still exposed in the water.

The method of procedure may be described as follows:—Thin foil of lead and copper was used, cut into pieces two inches square, and thus exposing eight square inches of surface. In the instance of the copper-foil it was effectually cleaned by immersing for a sufficient time in moderately dilute nitric acid, and afterwards washing in water. The lead was cleaned and made perfectly bright by rapidly rubbing with the back of a knife. The pieces were cleaned shortly before being immersed in the sea-water, and until ready for such immersion were kept covered by pure water. The quantities of sea-water (2000 grain measures in each instance) were poured into beakers, and one of the pieces of foil, copper, or lead as the case might be, was dropped into each. The beakers were then placed in a room above the laboratory, where they were covered by pieces of porous paper. The foil was occasionally moved about during the exposure.

I. *Lead.*—Even after the longest exposure—thirty-two days—no insoluble compound was suspended in the water or precipitated to the bottom of the beaker, but the surface of the foil was slightly coated with a deposit; it was tarnished. The standard solution of lead from which the comparison solutions were constructed was prepared by dissolving one grain of the lead foil in as small a quantity of nitric acid as possible and diluting with water to 2000 measures; each 100 measures being then equal to 0·05 of a grain of lead. The following results were obtained:—

Days Exposed.	Lead in Water.
4	0·000862509 grs.
7	0·001207500 „
14	0·001380000 „
32 (experiment 1)	0·000938750 „
32 (experiment 2)	0·000862500 „

These results show that from the fourteenth day of exposure to the thirty-second the quantity of lead in solution diminished (according to experiment 2) from 0·00138 to 0·0008625 of a grain, a quantity exceedingly small, but sufficient to distinctly show a diminution, and easily detected by the method adopted, in the quantity of water used—2000 grains.

I should explain that the determinations as above were made upon the contents of separate beakers, and in each

case on the day the lead foil was removed from the water, so that they were not all made on the same occasion. I felt it desirable to execute a fresh series of experiments in order to prove the accuracy, or otherwise, of the conclusion with regard to the amount of lead in solution diminishing on the foil and water being exposed for a lengthened period. Beakers were prepared with water and lead foil (sea-water of course) and exposed; but instead of determining the *quantity* of lead in solution, the lead foil was removed after the same lapse of time as in the former experiments just described, namely, after 4, 7, 14, and 32 days' exposure respectively, but the water from each exposure was kept, and the whole of the water samples tested with ammonium sulphide at the same time, and thus by comparing the several depths of colour produced by the various samples comparative results were obtained; these confirming the former ones and supporting the conclusion that the amount of lead in solution in the water diminishes on prolonged exposure along with the metallic surface. The same fact may be applied in the case of copper, as will be presently shown.

The action of sea-water upon lead is very slight, and by another experiment (by immersing in a fresh portion of sea-water a piece of lead foil used in the former experiments which had become tarnished, and testing the water after some days' exposure) it appears that no perceptible action is exerted by sea-water upon such tarnished metal.

II. *Copper.*—The experiments about to be described were conducted similarly to those on lead, and, therefore, upon that point I need not dwell. By the action of the sea-water upon the copper a green deposit insoluble in water (or nearly so), but exceedingly soluble in dilute acids, was formed, and this contained, as will be presently shown, the chief portion of the copper dissolved. This deposit was somewhat rapidly formed at the commencement of the exposure (some being observed at the bottoms of the beakers even after only twelve hours' exposure); but, after a time, this green compound apparently ceased to form, giving place to a thin but not easily removable covering of a bronze colour on the surface of the foil, on which the water ceased to act; on removing this tarnished foil, however, to some fresh sea-water, action again commenced, resulting, as before, in the formation of a green-coloured deposit. So as to find whether the bronze covering given to the copper by the sea-water prevented or not the action of other waters upon the copper, one of the pieces of tarnished foil was immersed in 2000 grain measures of soft river-water, and into a similar quantity of the same water a piece of *bright* copper foil of the same size was placed. After the expiration of five days the water was examined. It had acted considerably upon the *bright* copper, but only slightly on the tarnished—the copper dissolved in one case being about half as much as in the other. The tarnished surface, then, does not prevent totally the action of soft water upon the copper; or the tarnish is itself acted upon.

Before testing, in each case the green compound was separated from the water, so that the amount of copper might be determined in each separately. The following results were obtained:—

(*a*) Copper in solution in the water.

Days Exposed.	Copper.
4	0·00675 of a grain.
7	0·00350 ,,
14	0·00300 ,,
32	0·00300 ,,

Here we have an instance of the copper dissolved reaching its maximum, then between the fourth day and the seventh day diminishing from 0·00675 to 0·00350; but, as will be seen below, the green compound continued to form.

(*b*) Copper in the green deposit:—

In order to determine the amount of copper in the compound, it was dissolved in a very small quantity of dilute nitric acid, and the solution thus obtained diluted with water to 4000 measures. 100 measures of this solution were then taken and diluted to 1000 measures, to which ammonium sulphide was added, and the tint compared with that produced similarly in a standard copper solution—the results thus obtained being multiplied by 40 furnish the quantity of copper in the whole of the deposit as follows:—

Days Exposed.	Copper.
4	0·200 of a grain.
7	0·320 ,,
14	0·360 ,,
32	0·370 ,,

Adding the quantities of copper found in solution in the water to those found in the deposit, we obtain the following numbers:—

Days Exposed.	Copper.
4	0·20675 of a grain.
7	0·32350 ,,
14	0·36300 ,,
32	0·37000 ,,

As to the green deposit, I found it to consist chiefly of a chloride of copper, but I am at present unable to say what particular chloride, and as to its formation, I may add that by keeping copper-foil immersed in a solution of sodium chloride containing 53 grains in 2000 of water (about the quantity present in sea-water), no such deposit is formed, neither is it formed when copper-foil is kept immersed for some time in a solution of magnesium chloride.

Having made calculations from results given above, I append tables showing the action of one gallon (70,000 grains) of sea-water upon 280 square inches of each metal

The quantities are expressed in grains.

I.—LEAD.

Days Exposed.	Lead in Solution.
4	0·0301875
7	0·04226250
14	0·04830000
32 (expt. 1)	0·03285625
32 (expt. 2)	0·03018750

II.—COPPER.

Days Exposed.	Copper in Solution.	Copper in Deposit	Total Copper Dissolved.
4	0·28625	7·00	7·23625
7	0·12250	11·20	11·32250
14	0·10500	12·60	12·70500
32	0·10500	12·95	13·05500

Braystones, near Whitehaven,
March 14, 1877.

March 17, 1877.

POSTSCRIPT.—Since writing my paper, dated March 14, I have read in the CHEMICAL NEWS (of yesterday's date, March 16, p. 110) a paper by Mr. M. M. Pattison Muir, "On the Action of Water and Dilute Saline Solutions upon Lead" (read before the Manchester Literary and Philosophical Society, Feb. 6). I find from this that he has observed, while experimenting on the action of solutions of potassium carbonate, potassium nitrate, and ammonium nitrate upon lead, that the quantity of lead in solution *decreases* after a certain point has been reached. This is similar to the results obtained by me in the case of sea-water. As will be observed, my experiments also show that this peculiar fact applies in the instance of the action of sea-water upon *copper*. In the experiments with sea-water, however, the results mentioned could not be due to the same salts as used by Mr. Muir, as sea-water does not contain them.

AKADEMIE DER WISSENSCHAFTEN, VIENNA.

E. LIPPMANN and J. HAWLICZEK, "*Artificial Oil of Almonds.*" By changing the artificial oil of almonds obtained from the oxidation of $C_6H_5CHCl_2$ into benzyliden chloride, as well as by the oxidation products, and determination of the specific density, it is shown to be physically and chemically identical with the natural product.

E. LIPPMANN and J. HAWLICZEK, "*Nitro-benzoyl.*" By the action of HNO_3 and H_2SO_4 on oil of almonds the authors obtain, besides meta-nitro-benzoic aldehyd, the compound $C_7H_5(NO_2)O$ in the form of a heavy oil. It is insoluble in water, possesses a high specific gravity, does not combine with the acid sulphites of the alkaline metals; and by oxidation yields benzoic acid and nitric acid. In structure and deportment it is analogous to chloro-, bromo-, and iodo-benzoyl.

J. PLANK, "*Experiments on the Thermo-conductive Powers of* N, NO_2, *and* NH_3. The results with N and NO_2 coincide with the theoretical deductions of Boltzmann. For mixtures of NO and NO_2 the law of arithmetical means applies. With NH_3 much lower figures were obtained than those deduced from Boltzmann's or even Maxwell's formula.

M. HERLZ, "*Behaviour of some Ketons towards Oxidising Agents.*" The results of a large number of experiments on different ketons of the fatty series, with a variety of oxidising agents, show the correctness of Popoff's law, viz., that the alcohol radical containing the least amount of carbon remains joined to CO and forms one acid, while the radical containing the largest amount of carbon is oxidised to the second acid. Oxidation is, however, not confined to the formation of the two acids. In all cases CO_2 was formed, and lower homologues were present in small quantities. The author finds that all fatty acids are oxidised to a certain degree by sulphuric acid and potassium bichromate, contrary to the statement of Thorpe and Chapman.

G. NIEDRIST, "*Action of Water on the Halogen Compounds of Alcohol Radicals.*" Compounds with ethyl, isopropyl, and isobutyl are easily decomposed at 100° to 120°, forming the corresponding alcohols and hydrogen acids. Amyl chloride is attacked with difficulty, and amyl iodide is scarcely affected. At 150° ethylen-bromide undergoes the following decomposition, attended with a slight formation of aldehyd:—$C_2H_4Br_2 + 2H_2O = C_2H_4(OH)_2 + 2BrH$.

I. ZEIDLER, "*Behaviour of various Amylens towards Oxidising Agents.*" The amylen obtained from optically inactive amyl alcohol with $ZnCl_2$ yields carbonic, formic, acetic, propionic, butyric, oxalic, and succinic acids. That obtained by the action of alcoholic soda on amyl iodide prepared from optically inactive amyl alcohol yields carbonic, acetic, propionic, butyric, oxalic, and succinic acids. The amylen prepared by the action of phosphorus pentoxide on ethyl-amyl-ether gives carbonic, formic, acetic, propionic, and oxalic acids.

RUSSIAN CHEMICAL SOCIETY.

March, 1877.

P. LATSCHINOFF, "*Oxidation of Cholesterin.*" By the action of $KMnO_4$ on this substance the author obtains two monobasic acids, cholestenic acid, $C_{25}H_{40}O_4$, and oxycholestenic acid, $C_{25}H_{40}O_5$, and the dibasic dioxycholestenic acid, $C_{25}H_{40}O_6$. They are all soluble in ammonia, and yield amorphous salts with all metals except the alkalies. The author is led to adopt for cholesterin the formula $C_{25}H_{42}O[(C_{18}H_{37})_2H_2O]$.

F. BEILSTEIN and A. KURBATOFF, "*Substitution Derivatives of Benzene.*" These chloro- and nitro-derivatives have been already described (CHEMICAL NEWS, vol. xxxv., page 105.)

G. KRESTOWNIKOFF, "*On Iso-succinic Acid.*" In opposition to the statement of Byk, it is found that this acid is not produced by the action of potassium cyanide on chloro-propionic ether in alcohol. The reaction yields instead lactic acid and a new polymer of acrylic acid. The silver salt of iso-succinic acid is precipitated from the concentrated solution of the ammonium salt as a heavy granular mass. On the addition of water it is suddenly dissolved, and then immediately re-precipitated in the form of needle-like crystals. An attempt to obtain methyl-ethyl-acetic acid by the decomposition of ethyl-iso-succinate at a high temperature failed, the ether remaining unchanged at the boiling-point of mercury.

H. KANETNIKOFF, "*Action of Oxalate of Silver on the Bromides of the Olefines.*" The bromides of ethylen and propylen act in a similar manner to their homologues, the reaction producing instead of oxalic ethers, silver, bromine, carbonic acid, and ethylen or proplyen.

C. CECH and P. SCHWEBEL, "*New Formation of Iso-cyan-phenyl.*" The action of a dilute solution of caustic soda on dichloro-acetate of aniline yields hydrochloric acid, formic acid, and iso-cyan-phenyl.

NOTICES OF BOOKS.

The Composition and Character of the Water Supplied to London during 1876. By C. M. TIDY, M.B., F.C.S. London: Wertheimer, Lea, and Co.

THE London water-supply undergoes abundant supervision. Major Bolton examines and reports on behalf of Government. Parenthetically, and from an absolutely impersonal point of view, we must pronounce it strange that chemical and sanitary questions, such as the purity of a water-supply and the efficiency of methods of sewage treatment, should be referred, not to chemists or to medical practitioners, but to engineers, whether Royal or Civil.

From time to time, also, we have Dr. Frankland's reports on the quality of the Metropolitan waters, and now comes Dr. Tidy's memoir on the same important subject, as laid before the Society of Medical Officers of Health. The report of the last named gentleman may fairly be pronounced reassuring. The average amount of organic ammonia—by what method determined it does not appear—ranges in the waters delivered by the respective companies from 0·002 grain per gallon in the Kent to 0·007 in the West Middlesex, Southwark and Vauxhall, and Chelsea. The hardness before and after boiling varies little respectively from 14·0 and 3·0, save in case of the Kent, where the figures are 19·38 and 5·12. Whether we could by any practicable means produce a supply of water which, by the time it reached the consumer, would be of a decidedly better quality is very doubtful. Nor have we any warrant for supposing that the absence, or even the very great reduction, of the lime salts would be an advantage. Pure hydrogen oxide is a liquid which nature does not provide for us.

The waste of water at the present time is pronounced very great, "inasmuch as the quantity delivered on the intermittent system still in use in London is largely in excess of the quantity delivered in large provincial cities in which the system of constant service obtains." We believe that the intermittent system prevails wherever the water-supply has been committed to the tender mercies of a company, whilst constant service is the rule where the ratepayers take the matter into their own hands.

As regards the London water, Dr. Tidy expresses himself convinced that, "from a medical point of view, no substantial objection can be urged against its wholesomeness for dietetic and culinary purposes."

Bulletin of the Bussey Institution. Vol. II., Part 1. Boston: John Allyn.

THIS issue contains an interesting memoir by Prof. F. H. Storer on the amounts of potash and of phosphoric acid pre-

sent in several kinds of rocks. A specimen of granite from the south shore of Henshaw Pond, Leicester, Mass., was found to contain 7·434 per cent of potash and 1·191 per cent of phosphoric acid. Even sand yielded these two important constituents in relatively large amount. The idea that sand consists merely of quartz is declared false, and is very justly said to have given rise to many erroneous conclusions, both as to the comparative fertility of sandy soils; with regard to what is required by different kinds of plants from the soils that support them; and, in general, as to what constitutes the food of plants.

The same chemist has investigated the value of leather-waste as a manure. In its crude state it is absolutely worthless as a manure, but by roasting, some of the nitrogen is rendered assimilable, and a slight beneficial effect is produced. The author does not mention any experiments upon steamed leather, an article used by some English manure manufacturers as a source of nitrogen, nor upon leather treated with acids.

Third Report to the Sydney City and Suburban Sewage and Health Board upon the Quality of the Sydney City and Suburban Water Supply. By Prof. A. Liversidge, of the University, Sydney.

An examination of the water supplied to the City of Sydney, and of that found in certain pools and swamps in the immediate neighbourhood, and apparently used for domestic consumption. It appears from the analyses that contamination of a more formidable kind than decaying vegetable matter is making its appearance, so that there is good cause for the increased attention which the authorities are now evidently bestowing upon sanitary matters. The city water supply, as taken from dam No. 1, contained 0·05 part per million of free ammonia and 0·15 of albuminoid, but when freed from suspended matter these numbers were reduced respectively to 0·04 and 0·06. In the important item of albuminoid ammonia, therefore, the Sydney water is about equal to the New River and the Manchester supply.

CORRESPONDENCE.

DE HAËNS'S PROCESS.

To the Editor of the Chemical News.

Sir,—In reply to your correspondent "T. A." in the Chemical News (vol. xxxv., p. 188), I beg to say De Haëns has advertised his process by means of a pamphlet, giving practical details for its application, and which he will no doubt be happy to send to any one who will write to him to his place at Hanover for it.

There is nothing new in the plan. I laid the whole of it (with some important additions) before one of our principal boiler insurance companies in 1872. There is a difficulty arising out of the character of men employed as stokers; they don't like the additional trouble, and they have their own ways of making it not succeed. De Haëns's avowed motive is to sell his chloride of barium, which, however, can be more economically supplied in England.

The plan as set forth in the pamphlet aims only at—First, separating the lime, which exists dissolved in excess of carbonic acid, by Clarke's process, *i.e.*, saturating the excess of CO_2 by lime; and, secondly, by converting the sulphate of lime into chloride (muriate) by the addition of an equivalent quantity of chloride of barium. There is no attempt to separate the chloride of calcium (muriate of lime); it is left in the water, and he says it will be sufficient to blow off the boilers once in five or six weeks; but probably (driven as boilers are driven in England) once a fortnight would be necessary.—I am, &c.,

Alfred Payne, F.C.S.

Galen Analytical Laboratory, Wolverhampton, May 7, 1877.

FORMATION OF MOSS-COPPER, &c.

To the Editor of the Chemical News.

Sir,—Mr. Hutchings's notes last week were very interesting *per se*; but he has very much enhanced the interest to me by the presentation of some of the results of his experiments on *redruthite* and *argentite*.

Having very nearly recovered from "Nomenclature on the brain" since the establishment of the Mineralogical Society, and, knowing that a good deal of experimental interest is astir amongst some of the rising chemists about copper-growth from redruthite and regulus, perhaps it may save some investigators a little time and trouble and disappointment if you will allow me to observe that the kind of copper bisulphide referred to as redruthite has a good many *aliases*, *e.g.*, vitreous copper, *Phillips*; kupferglanz, *Haid.*, *Naum.*; cyprit, *Glock.*; kuprein, *Breith.*; chalkosin, *Beud* and *v. Kobell*; chalcosine, *Gregg* and *Lettsom*; chalcocite, *Dana* (in his "System"); redruthite, *Brooke* and *Miller*; nicol, *Percy* and "Watts's Chem. Dict.," v., 78; copper glance, *Jameson*, *Gmelin*, *Smythe*, *Bristow*, *Ramsay*, *Dana* (in his "Manual"), and *Maskelyne* at the British Museum.

I might be tempted into saying, "You pays your money and you takes your choice, gentlemen," if I was not bound to something like consistency by my initials, and stick fast to the notion that I prefer *copper glance* as applied to the sulphide in question, because in that expression there is *directness* of indication, and therefore more appropriateness.

Allow me a word or two on a novel mineral growth, which I have observed since my last note. Amongst my silver specimens I found a piece of argentite without any matrix (as it is called), three-quarters of an inch long, and five-eighths of an inch at its widest part. It has three more or less *pointed* portions protruding. The middle one has shot straight up quarter of an inch; it is a flat shape, just like a horse-shoe nail with flat edges; one surface is perfectly smooth and bright, and grooved somewhat all along its length as if it had been squeezed from the edges. One of the outside portions with the same general appearance, only terminating in quite a sharp point, has shot up, and at about two-thirds of the height of the last-named it suddenly took a horizontal turn, and bent quite round it, hook-like! The third appears to have shot up quite straight to about the same height, in one of the usual forms of argentite (or argentine) and then to have allowed an offspring to rush lovingly forward in touching salutation of the first-named party! These argentine graces, unconscious of beauty, are in truly graceful attitudes.

Such goings-on as these (and all within a year certainly) and so rudely (though naturally) ignoring the proprieties of civilised crystallising systems, &c., and without exuding native silver-growths, like old companion specimens, are to me an entirely new enigma. Possibly some of your world-wide readers may have observed parallel cases.

Since Mr. Hutchings wrote his letter I think I have more than half proved to him that "formations of native gold, silver, and copper *do sometimes* take place spontaneously, without any application of heat, steam, or hydrogen." Whether I may be allowed to continue to call them "growths" or not is a matter of no importance whatever.

Last Saturday we had the satisfaction of inaugurating the Liverpool Branch of the Mineralogical Society of Great Britain and Ireland, Mr. Alfred H. Mason, F.C.S.,

President. At that meeting I read a paper on "Metal Growth at Ordinary Temperature under Ordinary Conditions," an abstract of which I shall do myself the pleasure of forwarding in a few days.

In the meantime, however, allow me to say that I exhibited over 500 specimens, showing, possibly, ten times as many undoubtedly recent metal-growths. As to modes of occurrence, there were 5 examples in barytes, 5 in bismuthine, 13 in tetradymite, 2 in calcite, 1 in fluor, 4 in native copper, 3 in cuprite, 2 in copper pyrites (Dana's chalcopyrite), 2 in covellite, 1 in erubescite (Dana's bornite), 1 in tetrahedrite, 2 in native gold, 1 in leucopyrite, 9 in gossan, 1 (iron growth) in magnetite, 25 in iron pyrites (mundic or Dana's pyrite), 7 in marcasite, 21 in mispickel (Dana's arsenopyrite), 7 in galena (Dana's galenite), 1 in manganite, 6 in native silver, 7 in argentite, 1 in polybasite, 18 in blende, (Dana's sphalerite), and 315 in quartz! Upon rock masses were exhibited metal growths on chlorite, limestone, quartzite, sandstone, lower silurian greenstone, shale, schist, mica-schist, clay-slate, and mica-slate; silicon, sulphur, and arsenic appearing the most prominent actors in these interesting operations.—I am, &c.,

T. A. Readwin.

Tuebrook, Liverpool, May 7, 1877.

PS. "Sense," so printed in my last note, should have been *lense*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 16, April 17, 1877.

Researches on Iodic Acid.—M. Berthelot.—In this paper, which is of considerable length, the author describes the results obtained on causing iodine to act upon potassa, when the formation of hypo-iodous and of iodic acids was observed. He examines then the reaction of iodic acid upon water and the alkalies, and compares the thermic formation of the oxy-salts derived from chlorine, bromine, and iodine, seeking to deduce new data for molecular mechanics. He finds that the main chemical circumstances of the formation of the compounds of oxygen with the halogens agree with thermic data.

Divisibility of the Electric Light.—MM. L. Denayrouze and Jablochkoff.—The results obtained are the complete divisibility of the electric light; the absolute fixity of this divided light; the possibility of distributing large, small, or medium lights in all proportions, and in any part of the place to be illuminated; and the suppression of carbon points for small and medium lights.

State of Salts in Solutions.—M. D. Gernez.—The author finds that saturated solutions of sodic sulphate, prepared between 25° and 30°, or below, and left to cool, yield supersaturated solutions like those which have been heated beyond 33°. To prove this it is sufficient to filter these solutions, and collect them in tubes recently washed or heated, and then cooled. We eliminate thus from the liquid, or from the sides of the vessel, the particles of sulphate of soda which might provoke crystallisation. Solutions of sodic sulphate made at a temperature lower than 33°, and then left to evaporate in dry air, give crystals of a hydrate with 7HO, like those which have been raised to a temperature above 33°. This result is obtained either by eliminating the accidental solid sulphate, as indicated above, or by raising the temperature of the saturated and filtered solution a few degrees, but still always keeping it below 33°. In this manner we obtain on evaporation merely the hepta-hydrated salt, even with solutions made at low temperatures. Solutions made in the cold, *e.g.*, at 11°, introduced into one of the elbows of a W-tube, afterwards sealed at the lamp, and heated to 20° in contact with anhydrous sulphate contained in the other elbow, give the same hepta-hydrated crystals as those heated beyond 35°. The experiment is very decisive provided that the salt employed is perfectly anhydrous, and that the solution made in the cold does not hold any deca-hydrated crystals in suspension. These experiments prove that as regards the production of the two hydrates there is no difference between the solutions made below 33° and those which have been submitted to a higher temperature. We cannot, therefore, admit that the former are solutions of the deca-hydrated and the latter of the hepta-hydrated salt.

New Series of Acid Salts.—M. A. Villiers.—The author has obtained a series of acid salts formed by a neutral acetate with acetic acid and water. Of this series the biacetate of potassa of M. Thomsen, the triacetate of soda of M. Berthelot, and the triacetate of potassa of M. Lescœur form parts.

Transformation of Ordinary Pyrotartaric Acid into Hydrobromate of Tribromated Ethylen.—M. E. Bourgoin.—The author infers that there exist three substances of the formula $C_4H_2Br_4$; the perbromide of acetylen resulting from the direct combination of acetylen with bromine, and remaining liquid in a freezing mixture of salt and ice: the hydrobromate of tribromated ethylen, probably identical with the bibromide of bibromated ethylen, solidifying about $-17°$; the hydride of tetrabromated ethylen, which melts at 54·5°, a crystalline body corresponding to succinic acid.

Properties of Resorcin.—M. L. Calderon.—Reserved for insertion in full.

Gazzetta Chimica Italiana.
Anno vii., 1877, Fascicolo ii. e iii.

Elasticity of Metals at Different Temperatures.—G. Pisati (continued).—In the present chapter the author treats of elasticity of torsion in wires of iron, steel, copper, brass, gold, platinum, and aluminium.

New Group of Compounds, the Seleniureas, and Method of Determining Selenium in such Bodies.—Dr. P. Spica.—The author, in order to obtain selenurea, sets out from seleniocyanide of potassium, which he prepares according to the process of Berzelius, modified by Crookes. He succeeds in forming two derivatives, which may be regarded as urea in which selenium is substituted for oxygen. These are mono-benzyl-selenurea = $C_8H_{10}N_2Se$, and iso-dibenzyl-selenurea = $C_{15}H_{16}N_2Se$.

Relation between the Sum of the *Vis Viva* taken from the Luminous Ray by a Chlorophyllic Plant and the Sum of the *Vis Viva* obtained on the Combustion of the same Plant.—G. Musso.—A physico-botanical paper, not adapted for abstraction.

Purification of Manganic Chloride obtained from the Residues of the Preparation of Chlorine with Hydrochloric Acid and Native Peroxide of Manganese.—A. Pizzi.—The author, having separated the liquid by filtration from undissolved oxide of manganese, silica, &c., placed in the liquid zinc turnings. When the effervescence was over, the whole was heated to a boil for some time. The solution, yellow at first from ferric chloride, began to grow colourless, and then took a faint rose tint. The chloride of iron, like that of nickel, is decomposed in presence of zinc, whilst the chloride of manganese is unaffected. Having thus eliminated the iron, nickel, and the gelatinous silica, we have still in solution a part of the silicic acid, chlorides of zinc, lead, copper, cobalt, barium, and calcium, which metals are found in pyrolusite. The liquid is decanted off from any undissolved fragments of zinc, and to the solution is added pure

acetate of soda, along with some drops of acetic acid, and a current of sulphuretted hydrogen is passed through the liquid for some time. The zinc, lead, and copper are thrown down as sulphides, whilst the H_2S has no action on the chlorides of manganese, cobalt, barium, and calcium. The precipitate is thrown upon a filter and in the filtrate manganese and cobalt are precipitated with sulphide of ammonium, and the liquid is filtered anew. The precipitate is well washed to remove all traces of barium and calcium chlorides, and the second precipitate (of manganese and cobalt) is treated with hydrochloric acid. The sulphide of manganese dissolves, and is then separated by filtration from the sulphide of cobalt, which remains untouched.

French Association for the Advancement of Science.—Meeting at Clermont Ferrand, 1876.—A brief account of the chemical papers read.

Critical Researches on Certain Methods for Determining the Density of Vapours.—MM. Troost and Hautefeuille.—Taken from *Comptes Rendus*.

Journal für Praktische Chemie.
Nos. 1 and 2, 1877.

Composition and Properties of "Oxidised Sulphide of Platinum."—E. v. Meyer.—The heavy black powder obtained by the gradual oxidation of PtS_2 on the air is found to be, according to circumstances, either $PtS(OH)_2$ or $(PtS)_2O(OH)_2$, *i.e.*, hydrates of the as yet unknown PtSO. It acts as a strong oxidising agent upon H_2S. SO_2, HCl, NH_3, oxalic acid, ferrous salts, alcohol, and toluol, but does not affect NO or N_2O.

Sulphuryl Chloride and its conduct towards Alcohols.—P. Behrens.—Equivalent quantities of ethyl alcohol and sulphuryl chloride act upon each other as follows:—

$$SO_2Cl_2+C_2H_5OH=SO_2.Cl.OC_2H_5+HCl.$$

With water $SO_2Cl.OC_2H_5$ gives $SO_4HC_2H_5$ and HCl. Methyl and isobutyl alcohols yield corresponding compounds, decomposed in a similar manner by water. All of these compounds give with an additional equivalent of an alcohol derivatives of the general type $SO_2(OC_2H_5)_2$, decomposed by water into $SO_4.H.C_2H_5$ and C_2H_6O. The author prepared a number of mixed ethers of sulphuric acid in this manner, such as ethyl-methyl-sulphate, butyl-methyl-sulphate, &c. In the decompositions of these ethers with water, it was found that the hydrocarbon containing the least amount of carbon was separated from the molecule. Thus—

$$SO_4(CH_3)(C_4H_9)+H_2O=SO_4H(C_4H_9)+CH_4O.$$

The results all show that sulphuryl chloride and carbonyl chloride yield with alcohols perfectly analogous compounds.

Sulpho-dicarbonic Acids.—H. Welde.—The author has obtained the following four ethers of this class of compounds:—Ethylic-trisulpho-dicarbonate, $S(CSOC_2H_5)_2$, forming bright yellow crystals by the action of ethylic-chloro-carbonate upon potassium xanthate; and—

$$(C_2H_4)S_2(COOC_2H_5)_2,\ (C_2H_4)S_2(CSOC_2H_5)_2,\ \text{and}\ (C_2H_4)S_2(CSSC_2H_5)_2$$

by the action of $C_2H_4Br_2$ on the series $CO.SK.OC_2H_5$, $CS.SK.OC_2H_5$, and $CS.SK.SC_2H_5$. The latter three are separated out as oils.

Products from the Action of Fuming Nitric Acid on Illuminating Gas.—T. Akestorides.—The author finds that by conducting the gas through cold fuming nitric acid—besides nitro-benzen, nitro-toluen, and other nitro compounds—considerable quantities of oxalic acid are formed. The presence of the latter is due to the oxidation of ethylen and the homologues of benzen.

Herapathite and similar Acid Periodides.—S. M. Jörgensen.—The author has prepared a number of periodiselenates of quinine, chinidine, cinchonine, and cinchonidine, analogous in properties to the corresponding periodosulphates, and obtained in a similar manner by the addition of a hot alcoholic solution of HI and I to solutions of the alkaloids in selenic acid. He has also prepared numerous compounds of this class with other acids, such as quinine-periodo-hydrochlorate,—

$$3C_{20}H_{24}N_2O_2,5HCl,4HI,I_{10};$$

cinchonidine-periodo-tartrate,—

$$2C_{20}H_{24}N_2O,C_4H_6O_6,HI,I_2;$$

cinchonine-periodo-oxalate,—

$$4C_{20}H_{24}N_2O,2C_2H_2O_4,4HI,I_{10};$$

cinchonidine-periodo-arsenate,

$$2C_{20}H_{24}N_2O,2AsH_3O_4,HI,I_4;$$

and cinchonidine-periodo-phosphate,—

$$2C_{20}H_{24}N_2O,2PH_3O_4,HI,I_4.$$

The optical and crystallographical properties of the various compounds are described very minutely.

Compounds of the Metallic Oxides with Glycerin.—J. Puls.—The author describes an extensive series of experiments on the solubility of various metallic oxides in glycerin, performed by adding aqueous solutions of metallic salts to mixtures of glycerin and HKO. Clear solutions were obtained when glycerin, ferric oxide, and caustic potash were in the molecular proportions of 3 : 2 : 1 and 3 : 3 : 2. After a short lapse of time the ferric oxide is precipitated spontaneously from the solutions, and has passed into the colloidal state. Cupric oxide does not show this peculiarity. With weak solutions of glycerin the water appears to exert a neutralising influence upon the base present, which allows the solution of the oxide, but after a certain degree of concentration there is a fixed relation between the weights of glycerin and CuO dissolved. The author recommends the application of this fact for the analytical determination of glycerin. The hydrates of the alkaline earths are much more soluble in glycerin than the oxides of the heavy metals.

Compounds Formed by the Metals of the Tantalum Group, and on the New Metal Neptunium.—R. Hermann.—The author gives in a lengthy paper the latest results of the researches on this group of metals, which he has continued during the past thirty years. He brings together a mass of evidence to prove the existence of the metal *ilmenium*, the discovery of which he announced a number of years since, and by characteristic compounds and reactions dispels in a great measure the doubts raised against the claim by Marignac's investigations on the subject. The substance regarded by the latter as niobium is shown to have consisted of a mixture of niobium and ilmenium, and in one case of pure ilmenium. These two metals were obtained in the form of a black powder by heating the potassic double fluorides with K and KCl and treatment with water. In this condition niobium contains 0·726 per cent hydrogen and ilmenium 0·23 per cent. By heating in the air niobium is changed to Nb_2O_5, and ilmenium to Il_2O_5. While studying the peculiarities of these two metals the author discovered in a mixture of columbite and ferroilmenite from Haddam, Conn., a new metal, to which he assigns the name Neptunium. By fusion of the mineral with acid potassic sulphate the hydrates of the metallic acids were separated out in the following proportions:—

Ta_2O_5	32·39
Nb_2O_7	36·79
Il_2O_7	24·52
Np_4O_7	6·30
	100·00

The separation is accomplished as follows:—The hydrates are dissolved in HFl, and KFl is added. Upon the addition of 40 parts water the tantalum-potassium fluoride separates out entirely. By successive crystallisations the greater portion of the ilmenium and niobium fluorides are

removed, and a residual liquor is obtained, containing potassium-neptunium-fluoride, with small quantities of the niobium compound. An addition of HNaO precipitates amorphous sodium neptunate and crystalline sodium niobate. On account of the insolubility of the neptunate in boiling water it is easily separated from the niobate, and changed into the hydrate by fusion with acid potassium sulphate. Neptunium possesses the general properties of the other metals of the group. The hydrate is insoluble in mineral acids, with the exception of HFl. The solution of the fluoride is not precipitated with H_2S. The hydrate of neptunic acid is neither coloured nor dissolved by $(NH_4)_2S$. Tantalum fluoride and neptunium fluoride both yield with HNaO amorphous insoluble precipitates; illmenium and niobium give soluble crystalline precipitates. The solubility of neptunium-potassium fluoride distinguishes it from tantalum-potassium fluoride. The atomic weight of neptunium, as afforded by the analysis of the double fluoride $4KFl+Np_2Fl_7+2H_2O$, is 118. According to Hermann the atomic weights of the whole group are as follows: Ta, 176; Np, 118; Nb, 114·2; Il, 104·6. The colours imparted to beads of phosphorus salt in the inner flame of the Bunsen lamp by the acids of the four metals are—Ta, colourless; Nb, blue; Il, brown; Np, wine-yellow. The solutions of the sodium salts yield with tincture of gall-nuts the following characteristic precipitates:—Ta, light yellow; Nb, orange, Il, brick-red; Np, cinnamon-brown. The hydrates of the acids of Nb, Il, and Np yield with HCl and tin-foil deep blue solutions, while no colouration ensues with tantalic acid hydrate.

Nos. 3, 4, and 5, 1877.

The Three Isomeric Oxybenzoic Acids.—A. v. d. Velden.—The author finds that all normal salts of salicylic acid are decomposed by heating as follows—

$$2C_6H_4(OH).COOK = C_6H_4(OK)COOK + C_6H_5OH + CO_2$$

into basic salt, phenol, and carbonic acid. The salts of the heavy metals form also salicylic acid, and the Ag and Cu salts are entirely decomposed. By this reaction the salicylic acid in the K, Rb, and Tl salts is changed into paroxybenzoic acid. No change into the third isomeric oxybenzoic acid was noticed. By reduction with sodium amalgam, salicylic acid and paroxybenzoic acids yield only resinous products. Oxybenzoic acid is changed, however, into oxybenzyl alcohol, $C_6H_4(OH)CH_2OH$. This is a colourless odourless body closely resembling phenol in its properties, melting at 67°, and boiling at 300°. Various ethers and reactions are described at length.

Preparation of Hydriodic Acid.—H. Kolbe.—The method recommended by most text-books, of adding gradually 20 parts of iodine to a mixture of 15 parts of water and 1 part of red phosphorus, is found to be entirely incorrect. The author heats 1 part of yellow phosphorus with 10 parts of iodine, and, after cooling, adds 4 parts of water. On warming, pure hydriodic acid is given off in quantities.

Action of Sodium Mercaptide on CH_3I, CH_2I_2, and $CHCl_3$.—P. Clæsson.—In each case the halogens are replaced by SC_2H_5. The resulting compounds, with the exception of methyl-ethyl-sulphide, are oxidised at once on coming in contact with HNO_3, and yield ethyl-sulphonic acid.

Chloro-platinates, and Quantivalence of the Rare Metals of the Earth.—C. F. Nilson.—The chloro-platinates of all the metals, with the exception of the indium salt, $In_2Cl_6.5PtCl_4$, and the yttrium salt, $2Y_2Cl_6.5PtCl_4$, can be divided into three great classes—(1) Those in which the chlorine of the $PtCl_4$ group is double that of the basic chloride, as $2KCl.PtCl_4$; (2) those in which the relation is 4 : 3, as $Cr_2Cl_6.2PtCl_4$, including the hexavalent metals; (3) those in which the same amount of Cl is present in both, as $ThCl_4.PtCl_4$, including the tetravalent metals. The compounds of Di, Er, Ce, and La show the greatest similarity with the salts of the second group, and the analytical results, on the assumption that they are hexavalent, coincide with the atomic weights of the metals as recently obtained by Hildebrand from the determinations of the specific heat. A number of new chloro-platinates are described.

Volhard's Volumetric Estimation of Silver.—E. Drechsel.—The author finds the determination with potassium sulphocyanide unreliable, as long as AgBr or AgCl is suspended in the liquid, a decomposition under formation of AgSCN taking place. Liquids to be titrated must therefore be filtered before the addition of KSCN.

Ethyl Mercaptan.—P. Clæsson.—The author gives a very complete monograph on this substance and its compounds with most of the elements, a number of which he has obtained for the first time. Instead of forming the alkali derivatives by direct solution of the metals in mercaptan he makes use of the following reaction :—

$$NaOH + C_2H_5SH = NaSC_2H_5 + H_2O.$$

Platinum, palladium, and rhodium are the only members of the platinum group uniting with mercaptan, and this reagent is suggested for the preparation of the pure metals, especially for the separation of small quantities of platinum from osmium-iridium. Carbon mercaptides corresponding to CCl_4, C_2Cl_6, C_2Cl_4 were prepared by the action of $NaSC_2H_5$ on these bodies. The author has also obtained ethylic polysulphides, containing two ethyl groups combined with 1, 2, 3, 4, and 5 atoms of sulphur. With 5 atoms the maximum seems to be reached.

Behaviour of the Alkaline Sulphides towards Water.—P. Clæsson.—The author regards the solution of Na_2S, K_2S, &c., as containing a mixture of hydrate and sulph-hydrate, and the crystallised salt Na_2S+9H_2O as a double salt of the salt of the two.

Ethyl-sulphinic Acid.—P. Clæsson.—This acid, $C_2H_5SO_2H$, is obtained by the action of dry air on sodium mercaptide. Oxidation yields ethyl-sulphonic acid, ethyl-sulphone, and sulphuric acid,

Action of Ammonia on Alizarin.—H. R. v. Perger.—In addition to alizarin amide and alizarin imide, already obtained by Libermann and Troschke, a third body, apparently alizarin diamide is formed.

Normal and Basic Lead Chromate.—M. Rosenfeld.—If water be poured on a pulverised mixture of lead oxide and potassium chromate in the proportions $2PbO : K_2CrO_4$, red basic lead chromate is formed. With an excess of K_2CrO_4 chrome-yellow is formed.

Manganese Ores of the Bukowina.—T. Morawski and J. Stingl.—A number of analytical results are followed by theoretical considerations on the constitution of psilomelanes.

———

Reimann's Färber Zeitung, No. 16, 1877.

The leading article in this issue is an essay on the presence of magenta in wines. The author maintains that this adulteration is very rare; that it is impossible, save in very acid wines; and that, according to the researches of Bergeron and Clouet, magenta, free from arsenic, is perfectly innocuous, and is even beneficial in *Morbus Brightii*. The chemist to the police authorities of Berlin has, it is stated, examined a great number of samples of wine, but found only one containing magenta, and this one was, strictly speaking, not wine, but a highly acid vinoid mixture.

No. 17, 1877.

This issue gives an account of the legal proceedings taken by the firm of Poirrer, of Paris, to recover from certain fire insurance companies the amount of the damage caused by the memorable explosion on November 19, 1874. The defendants pleaded that they insured the premises only against fire, but not against explosions. As, however, the explosion was a consequence of the fire

which had preceded it in point of time a decree was given in favour of the plaintiff.

Revue Universelle des Mines,
Jan. and Feb. 1877.

On Tempered Glass.—M. J. Karpinski.—An account of the details of De la Bastie's process.

A number of brief chemical articles to be found in this issue are taken from the *Comptes Rendus*, and have been already noticed.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 40, April, 1877.

This issue contains no chemical matter.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 17, April 26, 1877.

This number contains no chemical matter.

Glass-Wool.—We have received from Messrs. Edward Rohde and Co. a specimen of "glass-wool." This material is introduced as a substitute for asbestos, and will, we think, be found useful in the laboratory for filtering and other purposes. It is of a silky texture, and resists the action both of acids and alkalies. It is also said not to lose weight on ignition.

MEETINGS FOR THE WEEK.

Monday, May 14th.—Royal Geographical, 8.30.
Tuesday, 15th.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Royal Institution, 3. "Chemistry of the Heavenly Bodies," Prof. Gladstone.
Wednesday, 16th.—Society of Arts, 8.
—— Meteorological, 7.
—— Pharmaceutical, 1. (Anniversary).
Thursday, 17th.—Royal Institution, 3. "Heat," Prof. Tyndall.
—— Royal, 8.30.
—— Royal Society Club, 6.30.
—— Zoological, 4.
—— Chemical, 8. "On a Slight Modification of Hofmann's Vapour Density Apparatus," M. M. Pattison Muir and S. Sugiura. "On the Fluid contained in a Cavity in Fluor-spar," J. W. Mallet. "Examination of Substances by the Lime Method," J. B. Hannay. "On the Dehydration of Hydrates," W. Ramsay. "Certain Bismuth Compounds, Part VI.," M. M. P. Muir. "Theory of the Luminous and Non-Luminous Flame," J. Philippson.
Friday, 18th.—Royal Institution, 9. "Physical Causes of Indian Famines," Lieut.-Gen. Strachey.
Saturday, 12th.—Royal Institution, 3. "Modern French Poetry," Mr. W. H. Pollock.

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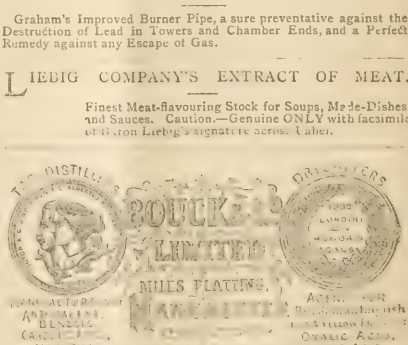


THE CHEMICAL NEWS.

Vol. XXXV. No. 912.

GASEOUS VOLUMETRIC ANALYSIS: THE DETERMINATION OF AMMONIA BY HYPOBROMITE OF SODIUM.

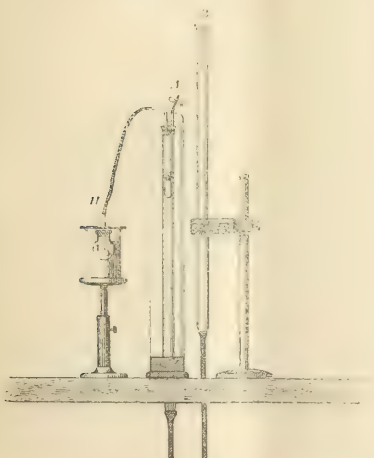
Preliminary Notice.

By E. FRANCIS.

The Chemical News (vol. xxxv., p. 81), containing an abstract report of a communication recently made by Messrs. Pruen and Jones to the Chemical Society on an apparatus for determining carbonic acid, has just reached the writer (March 20), and has induced him to furnish, somewhat prematurely, a description of an apparatus devised for a similar purpose, which he finds anticipated in principle by the authors of the communication specified.

The writer fulfils his intention of describing his contrivance not merely because it differs in many respects from the other in question, but chiefly because he wishes to show that the apparatus is available for other purposes besides that of carbonic acid estimation. It not only forms an efficient substitute for Scheibler's calcimeter and for Russell and West's ureometer, but it has been successfully used in determining ammonia, by a modification of Knop's method, with solution of an alkaline hypobromite as in the case of urea.

Fig. 1.



The estimation of nitric acid by Schulze's process and probably the valuation of manganese ores by an adaptation of Fresenius and Will's oxalic acid method can also be effected by its aid. Processes for the analysis of bleaching powder, and of peroxide of hydrogen have suggested themselves, but no opportunities have as yet been found for submitting them to experiment.

The gas apparatus constructed by the writer is shown in fig. 1.

A finely graduated burette of proven accuracy (A) is firmly fixed in a hole in the table, through which passes a caoutchouc connection to the plain tube (B) of equal calibre. The latter can be raised or lowered through a similar hole and is supported by a common clip. The tubes contain a convenient quantity of water, and on each surface of this rests a layer of paraffin oil of about 0·5 centimetre in depth.* An Erdmann's float facilitates accurate measurement. The burette is closed by a caoutchouc stopper fitted with two tubes, one of which leads by a flexible tube to the gas bottle (H), or to the apparatus shown in Fig. 2; while the other, furnished with a pinch-cock, serves for the adjustment of level after the gas bottle is connected.

The burette is surrounded by a cylinder of water, and the gas bottle is cooled by immersion in a separate vessel, a disc of sheet lead slit to the centre keeping it in position. The flask of an ordinary Parnell's carbonic acid apparatus makes a convenient gas bottle, and the tube enclosed is formed of the lower part of a five-eighths of an inch test-tube, broken unevenly so as to be readily introduced by the fingers while at the same time admitting of an easy transference of liquids.

Fig. 2.

The apparatus represented by Fig. 2 may often replace the simple flask and tube with advantage, as, for instance, in the estimation of urea in urine. It consists of a small burette with a fine orifice passed a short way through a caoutchouc stopper fitted to a flask provided with a lateral tube. A vulcanised tube connects the mouth of the burette to a short glass one, also passing through the stopper. Hypobromite solution being placed in the flask the burette is filled by disconnecting and applying suction to the end of the vulcanised tube at B, while the point of the burette (which need not be removed from the stopper) is dipped in the urine. A pinch-cock placed as shown in the figure regulates the passage of fluid. The flexible tube being rejoined and the stopper holding the filled burette replaced in the flask, the latter is ready for connection by the lateral tube to the gas apparatus. Successive measured quantities of urine or other liquid can then be submitted to the solution in the flask, and thus a number of determinations of gas be made at one operation.

The conditions regulating gaseous determinations of urea and carbonic acid have been so thoroughly elucidated by late writers—in the case of the former by Russell and West, Apjohn, and Dupré, and of the latter by Scheibler, Warington, and Pruen and Jones—that it would be superfluous to enter upon them here, and it needs but to say that the determinations can be effectively carried out by the above apparatus.

The determination of ammonia by hypobromite has not, however, received the same attention, and therefore the

* Mineral oil is much preferable to other oils, as it travels along the tubes without adhering.

writer ventures to record the results he has attained in this direction.

Ammonia, unlike urea, yields up the whole of its nitrogen under the treatment; the process is, therefore, more precise in the one case than in the other, and that it is easy, rapid, and accurate is evident from the following experiments:—

The alkaline hypobromite solution was prepared according to the directions of Russell and West (*Chem. Soc. Journ.*, vol. xxvii., 749) by dissolving 100 grms. of caustic soda in 250 c.c. of water, cooling the solution, and then adding 25 c.c. of bromine. Of this liquid 10 c.c. were used in the gas bottle in each of the following experiments:—

Example I.—A one-fifth normal solution of ammonium sulphate was prepared by dissolving 6·6 grms. of pure salt in water and diluting to half a litre. Quantities of 5 c.c. of this solution, measured into the tube of the gas bottle, and then mixed with the hypobromite solution in the usual way, gave of nitrogen at 29° C. and 29·962 inches pressure—

12·6 c.c.	12·6 c.c.
12·5 ,,	12·5 ,,
12·6 ,,	12·4 ,,
12·6 ,,	12·7 ,,
12·5 ,,	12·4 ,,

Mean, 12·54 c.c.

	Vol. of Gas Corrected for Temp. C.c.	Equal to $(NH_4)_2SO_4$ in Litre. Grms.	Equal to N in Litre. Grms.
Mean ..	11·21	13·212	2·802
Highest ..	11·36	13·388	2·840
Lowest ..	11·09	13·062	2·772
Theory ..	11·20	13·200	2·800

Or, according to the mean result, a quantity of nitrogen was obtained equal to 100·09 per cent of the theoretical amount.

Example II.—A two-fifths normal solution of ammonium chloride was prepared by dissolving 10·692 grms. (Cl = 35·46) of the salt in water and diluting to half a litre. From quantities of 5 c.c. of this solution there were obtained of nitrogen at 28° C. and 29·931 inches pressure—

24·7 c.c.	24·6 c.c.
24·9 ,,	24·6 ,,
24·6 ,,	24·7 ,,

Mean, 24·7 c.c.

	Vol. of Gas Corrected for Temp. C.c.	Equal to NH_4Cl in Litre. Grms.	Equal to N in Litre. Grms.
Mean ..	22·17	21·164	5·542
Highest ..	22·35	21·336	5·587
Lowest ..	22·08	21·080	5·520
Theory ..	22·40	21·384	5·600

Or the mean result represents 98·97 per cent of the theoretical nitrogen.

Example III.—In order to ascertain whether free ammonia could be estimated with equal precision a dilute solution, which was found by repeated titration with standard sulphuric acid to contain 4·958 grms. of NH_3 in the litre, was employed. Of this solution 5 c.c. gave of nitrogen at 29° C. and 29·930 inches pressure—

17·8 c.c.	18·0 c.c.
18·0 ,,	18·0 ,,
17·9 ,,	17·7 ,,

Mean, 17·9 c.c.

Corrected for temperature 16·0 c.c. Theory 16·33 c.c.

The mean result therefore shows 4·857 grms. of NH_3 per litre, or 98 per cent of the theoretical nitrogen. Although the result in this case is not so good it will be noticed that there is wider scope for errors of experiment in this than in the preceding examples.

Lastly, the following may serve to illustrate the mode of assaying an ammonium salt by this process.

Example IV.—Ordinary pure ammonium sulphate was dried in the water oven and 10 grms. of the dry salt were dissolved in water and made up to 500 c.c., thus forming a 2 per cent solution. Successive quantities of 5 c.c. were measured with a burette and decomposed in the gas apparatus with 10 c.c. of hypobromite solution. Each 5 c.c. of the solution would contain 0·1 grm. of the salt and should yield 16·97 c.c. of gas under the standard conditions. The quantities obtained at 29° C. and 29·912 inches were as under:—

18·9 c.c.	18·9 c.c.
19·0 ,,	18·8 ,,
18·7 ,,	18·7 ,,

Mean, 18·83.

Corrected mean, 16·83 c.c. = 0·917 grms. $(NH_4)_2SO_4$ in 500 c.c.

	Per cent of N in Salt.
Found	21·03
Theory	21·21

Or 99·15 per cent of the theoretical nitrogen was obtained.

The following convenient factors facilitate the calculation of results obtained by this process:—The number of c.c. of gas yielded by 5 c.c. of solution after correction, multiplied by 0·25, gives exactly the number of grms. of nitrogen in the litre; or if 10 grms. of the substance are contained in 500 c.c., as in the last example, the number of c.c. of gas (corrected) from 5 c.c. of solution, multiplied by 1·25, gives the percentage of nitrogen in the salt.

The above process, it is suggested, would form a useful adjunct to Peligot's soda-lime combustion method, as after the usual titration with the fixed alkali, an additional determination of ammonia can be made, in a measured quantity of liquid from the bulbs, by means of the gas apparatus.

Government Laboratory, Trinidad,
March 26, 1877.

ADDENDA.—It will be noticed that only one reading of the thermometer and barometer is given with each series of gaseous measurements in the preceding paper. This is owing to the well-known constancy of temperature and pressure found in the tropics, which admitted of each set of experiments being performed throughout under the same conditions. Moreover, the pressure being almost that of the standard—namely, between 760 m.m. and 761 m.m.—no correction, but merely a record of the initial observation, was necessary. The temperature was determined by thermometers suspended as usual in the water surrounding the burette and gas bottle.

A certain amount of heat is developed during the decomposition of ammonia by the hypobromite solution; therefore the contents of the gas bottle were allowed to cool after the reaction, either in the air or by dipping the flask in cold water previous to its final immersion in the vessel H. Each operation, from the measurement of the ammonia solution to the reading of the volume of the gas, occupied about fifteen minutes; the manipulative part less than five.

The tube B can be lowered as the gas increases in the burette. This precaution, however, is not essential, as the results were not influenced by a considerable difference of level being allowed to remain until the reaction was complete. Also, the solutions can be mixed either quickly or slowly with equal indifference. After mixing the solutions by inclining the gas bottle, the interior tube should be completely washed out with the hypobromite liquid by careful shaking.

The statement founded on the foregoing experiments, that ammonia yields up all its nitrogen under the action of hypobromite, is of course intended in a practical not in an exact sense.

QUANTITATIVE ANALYSIS OF SLAGS, FIRE-CLAY, BRICKS, AND IRON ORES.

By SERGIUS KERN, St. Petersburg.

THE method described is a shortened, and in details improved, ordinary method for the analysis of slags; but in its present form it is devised not only for slags but also for the analysis of most of the iron ores, fire-clays, bricks, and various fluxes used for smelting ores in blasting furnaces.

3 grms. of the powdered substance (in case of iron ores 1 grm.) intimately mixed with 5 grms. of dry sodium carbonate are ignited in a platinum crucible for one to two hours. The fused mass is dissolved in aqua regia, and next is evaporated to dryness. The residue is re-dissolved in hydrochloric acid, and 20 to 25 c.c. of water is added; the resulting precipitate of silica is filtered off, dried on the filter, ignited and weighed; next the percentage of silica in the substance is calculated. The filtrate is evaporated to 150 c.c., and at the ordinary temperature is neutralised by sodium carbonate till a reddish-brown precipitate is formed; the solution is next clarified by some drops of hydrochloric acid, and without applying heat the iron is thrown down by 30 to 40 c.c. of sodium acetate. The solution is heated on a sand bath for 10 to 15 minutes, and filtered accurately through a double filter eight inches in diameter. The precipitate is well washed till the liquor passing through the filter will give only a slight precipitate with a mixture of oxalic acid and dilute ammonia. This filtrate, which we will call A, is placed aside. The double filter with the precipitate is placed in a porcelain dish, in which the filter is taken out, washed with water, which is poured into the same dish. The liquor is heated, and the precipitate of iron is re-dissolved in hydrochloric acid, filtered and neutralised by sodium hydroxide; this solution is poured into a silver dish containing 5 grms. of potassium hydroxide dissolved in 20 c.c. of water. This liquor is next heated to 80° to 90° for half-an-hour. Water is added in a quantity of 100 to 120 c.c., and the solution is filtered: this filtrate we call B. The hydrated oxide of iron on the filter is re-dissolved on the filter by hydrochloric acid, and from the filtrate the iron is precipitated by ammonia. The precipitate is dried and ignited; the resulting iron oxide (Fe_2O_3) is weighed, and the percentage of iron is thus calculated. The filtrate B, containg only alumina in solution, is slightly acidulated by hydrochloric acid, evaporated to 80 to 100 c.c., whence the aluminium is precipitated by ammonium carbonate in excess. The liquor is heated till all the ammonia goes off, and the precipitate is collected on a filter, dried and ignited. The resulting aluminum oxide (Al_2O_3) is weighed.

The filtrate A, containg manganese, calcium, and magnesium, is evaporated to 100 c.c., and from the liquor, heated to 40°, the manganese is precipitated by 8 to 10 drops of bromine in the form of hydrated manganese dioxide. This precipitate is collected on a filter, dried, ignited, and the resulting mangano-manganic oxide is weighed. The remaining liquor, after the separation of manganese, is mixed with 20 c.c. of hydrochloric acid, and evaporated on a gentle heat to 80 c.c. The liquor is slightly cooled by adding 40 c.c. of water, and 20 c.c. of oxalic acid is next added in order to throw down the calcium; to the solution is added an excess of ammonia, and it is left for ten hours in a warm place (30° to 40°). The precipitate, consisting of calcium oxalate ($CaC_2O_4+H_2O$) is carefully collected on a filter and strongly ignited. The crucible with the mass is cooled over sulphuric acid and quickly weighed. As the CaO obtained contained 71·42 per cent. of calcium, the percentage of Ca in the substance is easily found. The remaining filtrate containing magnesium is gently heated, and 200 c.c. of a concentrated aqueous solution of hydrogen di-sodium phosphate—

$$(HNa_2PO_4+H_2O)$$

with 30 c.c. of ammonia is next added. The solution is carefully mixed and left for 12 to 15 hours in a warm place. The resulting precipitate of $MgNH_4PO_4+6H_2O$ is collected on a filter, washed, dried, and carefully ignited till constancy in weight is obtained. This residue is $Mg_2P_2O_7$, which contains 36·04 per cent of magnesium.

This process is with success adapted to the analysis of various products of metallurgical operations. It has been used some time in several Russian laboratories. The manipulations are easy, and quickly executed.

Obuchof Steel Works.

ON THE OXIDATION OF SILVER AND PLATINUM BY OXYGEN IN PRESENCE OF WATER.*

By WILLIAM SKEY,

Analyst to the Geological Survey of New Zealand.

I SHALL confine myself in this paper to a statement of results, and the considerations which led me to seek them, as I intend leaving the discussion of these in their various relations to certain debateable subjects for another opportunity, my investigations upon this matter being as yet incomplete.

A knowledge of the fact that gold and platinum readily combine with sulphur at a common temperature, and that the compounds thus formed cannot be detected by mere physical tests, suggested to me that oxygen may also combine with these metals under conditions somewhat similar, and in this manifesting none of the more distinguishing signs of chemical action, has consequently to this time been overlooked.

Acting at once upon this suggestion, I forthwith made a series of experiments to test the correctness or otherwise of my suspicion, and the results of these experiments, showing them in the main, I believe, to be correct, I submit them to your notice.

I should premise my statement of these results by informing you, in anticipation of what will in due course appear, that one of my principal tests for the oxidation of these metals is that known as the "mercury test," by which it will perhaps be remembered I had the honour of demonstrating before you experimentally the sulphurisation of gold by sulphuretted hydrogen; and that this test is based upon the fact that mercury readily amalgamates with silver or platinum when in contact with them, but that if the minutest film of any substance intervenes between the two metals, amalgamation is either retarded or altogether prevented; thus, by the aid of this test, minute quantities of a substance enfilming either of these metals may readily be detected.

Commencing with silver, I ascertained the following facts regarding it:

1. That pure silver immersed for a few hours in distilled water or in the purest water I could obtain, has its surface so modified that it will not amalgamate immediately afterwards.
2. That such an effect is not produced when either rain or spring water is used.
3. That silver thus modified by distilled water is brought back to the amalgamable state by contact for a short time with rain or spring water, also with acetic acid or ferrous sulphate, also by raising its temperature to about 500° F.
4. That electric currents are generated by this metal in saline water free from chlorides, iodides, or bromides, also in water charged with any of these salts.
5. That in dry air silver does not pass into this non-amalgamable state.
6. That spongy silver immersed in an aqueous solution of sodic chloride (in an agate vessel) soon renders it very alkaline.

* Read before the Wellington Philosophical Society, January 29th, 1876.

These results, taken conjointly, signify, I think, undoubtedly that silver is a metal which oxidises in a superficial way with far greater facility than we have heretofore considered possible.

Thus, in experiment 1, I hold this metal is oxidised by atmospheric oxygen contained in the distilled water used, and the oxides of silver not being reducible, or at least readily reducible, by mercury, amalgamation is prevented or greatly retarded. With water containing chlorides in experiment 2, we must suppose the silver has also oxidised, but the oxide thus formed has been decomposed by the alkaline chlorides present, argentiferous chloride thus resulting as a secondary product, and this compound, being, as we know, readily decomposable by mercury, amalgamation proceeds with rapidity. However, in regard to silver thus acted upon by chlorides, I always noticed that amalgamation did nor appear to proceed instantly when it was placed in contact with the mercury as clean silver does; there was, as it were, a momentary hesitation manifested by the mercury before amalgamation proceeded.

The effect of acetic acid and of ferrous sulphate in experiment 3 is perhaps referable to a solution of argentiferous oxide in the one case, and to its reduction in the other. At the same time, however, we must consider that basic and insoluble silver salts may form here, and these, being readily decomposable by mercury, amalgamation is not retarded. The facts, Nos. 4, 5, 6, I think will be seen corroborative of the correctness of the conclusions I have above drawn.

I may state in further support of this conclusion that I have observed silver, as precipitated from its nitrate, darken near the surface of the solution, and it is only colourless and lustrous where distant therefrom, or when overhung by masses of silver. This darkening I attribute to a superficial oxidation of the silver by the atmospheric oxygen which has permeated the solution used. This metal also, contrary to general belief in regard to it, decomposes mercuric chloride. All these results were in the first place obtained from the metal electro-plated from its pure cyanide upon silver wire; but afterwards, for greater certainty in the matter, I employed silver most carefully prepared, and by improved processes for pure silver. As electro-plated upon lengths of surgical wire, it is most easily worked, and being thus in a spongy form, its behaviour with the mercury test can be minutely and readily observed. It is necessary, of course to well wash this silver from alkaline cyanide by distilled water before using it in these experiments. I should inform you I could not observe that sun-light exerted an effect in any of these reactions, whether accelerating or retarding.

In regard now to the metal platinum, I ascertained that it is also passed to a condition in which it will not amalgamate, by giving it contact for a short time with distilled or ammoniated water, also with aqueous solutions of the alkalies, their carbonates or chlorides, while acids generally put it quickly back into an amalgamable condition; an elevation of its temperature to about 400° F. will also accomplish this.

Platinum also generates electric currents when paired with graphite in saline or alkaline solutions.

These facts, I think, show undeniably that platinum not only absorbs oxygen, as is already known, but that this absorption is, in the cases cited, a chemical one, an oxide or a suboxide of this metal being formed. That in the so-termed mechanical absorption of certain gases by platinum, platinic compounds are produced, is an idea which I have long since entertained.*

In conclusion, I would beg to inform you that, from a partial investigation of the behaviour of gold in certain liquids, I believe this metal is also oxidisable under conditions somewhat similar to those under which I have stated silver to be, but the results of this investigation I will endeavour to communicate at our next meeting.

* "Trans. N. Z. Inst.," Vol. iii., Art. xxxviii.

A NEW QUALITATIVE REACTION FOR BORACIC ACID.*

By MALVERN W. ILES, Ph.B.

Assistant Qualitative Laboratory School of Mines, Columbia College

WHILE working upon various nickel and cobalt salts, Dr. C. A. Joy suggested trying the action of glycerin, its solvent power, and prevention of precipitates with these compounds. I had nearly finished the investigations when it occurred to me that my experiments would not be complete unless I tried the action of glycerin upon nickel and cobalt in a borax bead; I accordingly dipped a borax bead containing both nickel and cobalt into glycerin, and gently heated before the blowpipe. I observed that the glycerin burned with a very faint blue colour, which soon changed into a green, and that a carbonaceous mass, entirely encrusting the bead, remained: this was repeated several times with the same result, and an odour of acrolein was noticed.

Thinking it very singular that such difficultly reducible metals as nickel and cobalt should thus be volatilised, giving a coloured flame, I tried glycerin alone upon an elongated platinum loop, and held it in the flame of the Bunsen burner. There was a little sputtering at first, but it soon caught fire, burning with a faint blue colour, the apex having a yellowish tinge, while immediately around the wire no colouration at all was perceptible. The outline of the flame was not well marked, and a soda flame lit up just before extinction. I then tried, separately, nickel and cobalt in a borax bead, and without the aid of a blowpipe, as I had found this unnecessary in the experiment with glycerin alone.

The nickel bead was held in the Bunsen flame until it assumed a dull red, then immersed in glycerin, gently heated, and removed. The mass caught fire, burning first with a yellow, then a deep green flame!

The same phenomenon was noticed with a cobalt bead.

It soon occurred to me that it would be well to try a borax bead alone with glycerin, when I was surprised to see the same green flame.

This last experiment showed conclusively it was not the nickel or the cobalt, but the borax bead, which was the cause of the colouration.

I next tried datolite, as it contains no soda, with glycerin, and, although the green flame for boracic acid was obtained, the result was not as satisfactory as anticipated; in fact, I have not since found a single borate to work so unsatisfactorily as this.

In subsequent experiments I found, however, it was best first to calcine the mineral, powder and moisten with sulphuric acid, heat to expel the acid, then to moisten with glycerin and allow to take fire. Thinking that the carbon exerted some action upon the borate, finely-divided charcoal and a borax bead were tried, but they gave negative results.

Glycerin and sodium carbonate bead gave simply a yellow flame. Various metallic bases in a sodium carbonate bead and glycerin also gave negative results in regard to flame. A "salt of phosphorus" bead and glycerin gave the light green phosphoric acid flame, but of less intensity than that noticed when a potassium chlorate match is burned. Quite a large number of bases and acids were also experimented upon in connection with glycerin, using different beads; also substances treated on charcoal with glycerin, with various results, some of which were without doubt sufficiently characteristic for qualitative reactions.

These I must pass, not being immediately pertinent to the subject.

In order to test the general applicability of this reaction the following among other borates were tried:—

* Read before the Chemical Section of the New York Academy of Sciences.

1. Sodium borate (borax).
2. Ammonium borate (Larderellite).
3. Barium borate.
4. Calcium borate.
5. Cobalt borate.
6. Nickel borate.
7. Cadmium borate.
8. Zinc borate.
9. Manganese borate.
10. Iron borate.
11. Tin borate.
12. Silver borate.
13. Uranium borate.
14. Lead borate.
15. Boro-natro-calcite.
16. Borax in a soap.
17. The residue from commercial borax after thorough washing with distilled water.
18. Ulexite.
19. Tourmaline.
20. Cryptomorphite.
21. Sussexite.
22. Bismuth borate.
23. Strontium borate.
24. Chromium borate.
25. Aluminium borate.

In every case conclusive reactions were obtained, and in a number of borates the glycerin test for boracic acid seemed far more delicate than any of the known methods for the detection of this acid.

The borates of tin, barium, cobalt, nickel, cadmium, zinc, manganese, iron, silver, uranium, bismuth, strontium, chromium. and aluminium, were made by taking a concentrated solution of borax, filtering from the white flocculent residue, and adding the filtrate to a soluble salt of the metal under consideration; then washing the precipitate thoroughly with distilled water. The residue from commercial borax was found to contain alumina, silica, calcium, and boracic acid, the latter being detected by glycerin.

On the borax residue a comparison was made between this test and that of Turner, who uses 4½ parts hydrogen potassium sulphate, and 1 part calcium fluoride.

The glycerin test was found to be far more delicate.

In a few cases Turner's test might be advantageously used, especially in very refractory silicates, containing a minute trace of boracic acid; yet I must state that in no case have I found Turner's test to give reactions for boracic acid in which the glycerin test was not perfectly reliable and conclusive.

In my first attempts to obtain a reaction for boracic acid in tourmaline I was unsuccessful, on account of the mineral not being sufficiently pulverised.

There is, however, no difficulty in detecting boracic acid if the mineral be *very finely powdered* in an agate mortar.

Test for Boracic Acid in Soap.

Dr. C. F. Chandler having some soap in which borax was suspected, sent the sample to the Qualitative Laboratory at the School of Mines, where repeated attempts were made to detect the boracic acid, by means of turmeric paper and the alcohol test, but without avail.

Subsequently, having discovered the glycerin test, I applied it to this material, obtaining satisfactory results.

Of course sodium, the great obscurer, tends to diminish the delicacy of this reaction. I was led to make my first experiments with a sodium carbonate bead, thinking I must have some menstruum for the borate. This I have found entirely unnecessary, as an elongated loop of a platinum wire, first dipped into glycerin, then into the fine powder, is found far more effectual. I have, however, been experimenting to determine the exact limit at which the boracic acid flame is obscured by the soda. I find if 1 grm. sodium carbonate (C. P. anhydrous) and 1 grm. crystallised boracic acid be intimately mixed, that the green flame is still distinctly perceptible.

I will now enumerate some of the most striking reactions in my experiments with borates in connection with glycerin:—

Borate of Nickel.

This, when heated with glycerin in the reducing flame before the blowpipe, throws off a shower of scintillations: these, when collected, gave a strong magnetic reaction.

Borat of Cobalt.

This, if heated with glycerin and the bead powdered, shows a slight magnetic reaction.

Borate of Cadmium.

This seems to manifest a decided spurting tendency, as if there was confined gas in the mass, similar to the action when bituminous coal is burned.

Borate of Lime.

This fuses easily before the blowpipe to a clear glass, and gives no flame alone for boracic acid. The fused borate moistened with glycerin gave a reaction for boracic acid, but by taking the borate finely powdered, and making a magma with glycerin, the most satisfactory results are obtained.

The carbonaceous mass, after heating with glycerin, has an alkaline taste, and does not effervesce with dilute hydrochloric acid.

Borate of Silver.

This borate was thoroughly washed to free it from any traces of boracic acid; so thoroughly, indeed, that a part was decomposed by the hot distilled water, so as to give argentic oxide. On trying the borate with glycerin, the deepest shade of green yet noticed, with a borate, was obtained.

The silver was reduced to the metallic state.

The spectroscope showed no silver lines, as was anticipated from the intensity of the green colour.

Borate of Lead.

This gave a green almost equal to that noticed with borate of silver. The lead was reduced to the metallic state. I noticed also that when an oxide of lead is treated with glycerin, in a porcelain crucible, the lead is reduced to the metallic state, and is seen encrusting the light, porous, carbonaceous mass in fine globules, no button being found at the bottom of the crucible.

The Boron Spectrum.

The spectroscope shows a beautiful boron spectrum, if boracic acid or a borate be moistened with glycerin and gently heated in a Bunsen flame; the volatile boron compound being given off for some time, and tinging frequently the entire length of the Bunsen flame. The scale was so arranged as to place the sodium line at the division marked 50, as given by Roscoe (Frauenhofer's D). According to Mr. Douglass A. Joy and myself, four distinct green bands were noticed, as follows:—

First line—Broad, distinctly green line from 63 to 66.
Second line—Green line from 77 to 80.
Third line—Green line from 89 to 92, not as distinct as the first and second lines.
Fourth line—An indistinct green line from 104 to 105, the outline not being well marked. Sometimes. however, by immersing the borate in glycerin the second or third time, the line flashes up quite distinctly.

It will be seen from the above that the four lines are essentially equidistant. The first and third lines are of equal breadth. These observations were found to closely coincide with the statements given by the best authorities. We therefore see that glycerin presents an easy and practical method for the spectroscopic observation of boron; while it will be remembered that the boracic acid flame produced by alcohol and sulphuric acid presents many difficulties, and withal this method would only be applicable to boracic acid and not to borates.

The transient nature of the green flame produced by Turner's test renders its use before the spectroscope of exceeding difficulty.

By an application of the spectroscopic method for the detection of boracic acid, above mentioned, the scientific geologist or mineralogist may find borates to play a much more important *rôle* in nature than heretofore believed, since it was simply the ease with which the strontium and lithium lines could be viewed that these elements were found, according to Dr. Roscoe, to be most widely spread throughout the matter composing the solid portion of our planet,

Both copper and barium have the property of giving green flames; hence salts of both these metals (especially the chlorides) will interfere more or less with this test; but this is not as great an obstacle as would at first appear, since boracic acid is not found associated in nature with either of these elements (according to Dana's "Mineralogy"); hence the test is generally applicable to minerals. When barium is associated with boracic acid in artificial compounds the substance may be moistened with sulphuric acid, thus forming barium sulphate, incapable of giving a green flame, and the boracic acid, if it previously existed in a state of combination, is now in a more fit condition for the glycerin test.

It will be remembered that the green flame of barium is not like that of copper; also these flames may be easily distinguished, since copper salts impart to flame a deep blue when moistened with hydrochloric acid. I have noticed that neither borate of copper nor borate of barium impart the slightest trace of green when heated on a platinum wire; but when either of these borates are moistened with glycerin the characteristic green for boracic acid is noticed. Thinking this last statement might be called in question, copper borate and barium borate respectively were heated alone on a platinum wire, and on looking through the spectroscope nothing but the sodium line was made manifest. I then moistened these compounds with glycerin, obtaining in both cases an excellent boron spectrum, but not a single line of barium or copper.

For qualitative purposes, when copper has been found in the substance for analysis, I know of no better mode of procedure than its removal by hydro-sulphuric acid or ammonium sulphide.

Watts's "Dictionary" distinctly states, "Before the application of the flame test for boracic acid care must be taken to insure the complete absence of copper." It also states, "Certain chlorides colour the flame green, as when hydrochloric acid is dropped into an alcohol flame. Phosphates moistened with sulphuric acid also give a faint green colour to the outer blowpipe flame."

Besides the green colouration produced by boracic acid, copper, barium, and phosphoric acid, previously mentioned, thallium, tellurous acid, and molybdic acid, also impart a green flame.

But these are of such rare occurrence that their absence can be generally assumed.

I will state, however, that since thallium is so easily volatilised, this element may be entirely removed before the application of the glycerin test.

Turner's Test.

In regard to Turner's test Watts's "Dictionary" states —"If the quantity of boron is small the green flame lasts only for a few seconds, ceasing, in fact, as soon as the fluoride of boron is completely volatilised."

Plattner says—"This colouration is very transient, and must be looked for with *great attention*."

Merlet says—"Three to four parts of the flux are requisite to obtain a sure result."

Fresenius states—"The yellowish green tint by this test (Turner's) is only for a very few instants."

I have found Turner's mixture greatly deteriorates in value on keeping, a fact which I think has been generally overlooked. On analysis of calcium fluoride, as generally found in laboratories, I have found, besides the calcium and fluorine, the following:—Alumina, silica, sulphuric acid, iron, and some soda.

Whether a part of the sulphuric acid of the acid sulphate acts upon any of the bases, iron, alumina, or soda, I am unable to say, but think it a very probable explanation of the deterioration noticed.

Alcohol and Sulphuric Acid Test.

In regard to the alcohol and sulphuric acid test, it will be remembered the flame is yellowish green, while by the glycerin test the flame is deep grass-green.

Fresenius states—"The presence of metallic chlorides also may lead to mistakes, as the chloride of ethyl formed in that case colour the borders of the flame greenish."

Turmeric Paper Test.

In regard to the turmeric paper test, I will state that the "blackish brown colour," as Fresenius terms it, which turmeric paper acquires when moistened with concentrated hydrochloric acid, is not at all likely to be mistaken by the qualitative student for the so-called "peculiar red," which is too often desired in vain: turmeric paper, however, does receide from hydrochloric acid of a certain degree of concentration tints which are very likely to mislead. Also the presence of a certain amount of ferric chloride has a great tendency to deceive. Acid solutions of molybdic acid or zirconia are also a cause of error.

The Chemistry of the Reaction.

Considering the complex nature of the resultant products from the decomposition of glycerin, and the number of peculiar reactions for the element boron, I hesitate to venture an opinion upon the chemistry of this reaction. I have made, however, a simple experiment that proves I am not altogether wrong.

Boron being known to form volatile compounds with alcohol or boric ethers, which burn with a green flame, and glycerin being a true triatomic alcohol, I was led to make the following experiment:—

Taken, about 2 grms. pure crystallised boracic acid, and 7 c.c. glycerin (94 per cent) heated in a small beaker until the boracic acid was all dissolved; then introduce the liquid into a small glass retort and gently heated. A clear limpid liquid soon condensed on the upper side of the retort.

This distillate when examined had a sweetish, mildly acid taste, gave a distinctly acid reaction to blue litmus, and showed a minute tinge of green when burned. As the operation proceeds the liquid in the retort becomes slightly turbid, soon darkening in colour to a reddish brown, the distillate asssming the same tint. The second portion of the distillate had a pungent taste and an odour of acrolein, showed an acid reaction, and when heated on platinum foil burns with a beautiful green flame. This compound is undoubtedly, therefore, a boric ether, the composition of which has not yet been determined.

In conclusion I will state I have frequently known students of the Qualitative Laboratory of the School of Mines to report boracic acid in substances in which no such acid existed, basing their conclusions on the alcohol or turmeric paper test, more especially upon the latter; and when the reddened paper was brought to me for inspection I could not do otherwise than state the colour seemed to indicate the presence of this acid.

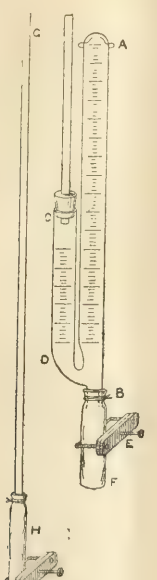
The students have now used this glycerin test for over four months, and, I am pleased to state, with entire satisfaction.

Purification of Bismuth.—M. E. Smith adds to 16 parts of bismuth, kept in fusion at the lowest possible temperature, 1 part of a mixture of 8 parts of cyanide of potassium and 3 parts flowers of sulphur. After fifteen minutes the metal is allowed to cool.—*Bull. de la Soc. Chim. de Paris.*

A NEW FORM OF APPARATUS FOR GAS ANALYSIS.

By THOMAS M. MORGAN.

The apparatus which is the subject of the present communication does not possess the merit of rendering an analysis of gases more accurate than can be done by apparatus at present in use, but it is simple in construction and requires but a small supply of mercury. The eudiometer tube AB is drawn out at B until it has a diameter of 5 or 6 m.m.; C D, a shorter piece of the same tubing, is sealed on at one side in the manner shown in the figure, and both tubes have corresponding m.m. scales etched upon them. The capacity of the divisions on A B must be known and can be determined by Bunsen's method. The same tube has platinum wires at A, and to B a piece of strong caoutchouc tubing is firmly secured and provided with a clamp E. The apparatus is filled with mercury through F or C; in the former case C must be closed with a cork, in the latter B F is compressed by the clamp E.



If C D be kept closed with a cork, the gas may be introduced by a small funnel at F, when the apparatus is held obliquely over the mercury trough, with C D uppermost; or a delivery tube may pass down C, while E is opened sufficiently to allow the displaced mercury to escape; or should the gas be in a sealed tube, the latter is attached to F, E is opened for the expulsion of enclosed air, and the point is then broken off; if the gas is under pressure its admission may be regulated by stopping the end C with the thumb.

Before measuring the mercury in the short limb is brought to a proper level by allowing a sufficient quantity to flow out at B, and that a known temperature may be quickly arrived at the apparatus is placed vertically in a cylinder of water, the short limb being fitted with a long tube open at both ends, as shown in the figure; the volume, temperature, and pressure are then read off.

Any absorbent to which the gas may have to be submitted is placed in the short limb and caused to pass into the long one by allowing mercury to run out below until a sufficient quantity has entered; the short limb is then filled up with mercury, closed, and by agitation the absorbable constituent is removed, or the apparatus may be let stand the requisite time.

The absorbent is removed by means of a stout glass tube (G H), 1 m.m. internal diameter, and considerably longer than the eudiometer; one end has a strong caoutchouc tube and clamp attached to it; the other, after being rubbed with a little grease, is inserted at F and tied sufficiently tight to prevent escape of mercury, and yet to allow of freedom of motion up and down; by gradually opening the clamp E, the air is carried out of this tube and it is left filled with mercury. The clamp H is then closed, that at E is opened to its fullest extent, and the tube is thrust up until it is within 2 m.m. of the absorbent; then as a slow stream of mercury is allowed to descend, it is alternately raised into the liquid and pulled down below it; portions of absorbent and mercury thus follow each other down the tube, but it is evident that if a proper proportion of the latter be not drawn in, the current will cease, after one or two trials it is not difficult to leave a meniscus free from liquid; should any of the gas enter it may be expelled again by quickly compressing the tube at the bottom. In order to obtain the residual gas saturated with aqueous vapour of normal tension, a little pure water may be introduced and removed in the manner described.

An estimation of nitrates and nitrites by Frankland's method may be made in this apparatus, and I have also used it in an organic analysis by Schulze's method ("Watts's Dict.," 1st suppl., p. 143).

The apparatus may be strengthened and made more convenient for manipulation by attaching it to a light wooden frame.

Victoria College, Jersey,
April, 1877.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

May 12th, 1877.

Professor G. C. Foster, F.R.S., President, in the Chair.

The following candidates were elected Members of the Society:—Capt. R. Y. Armstrong, R.E.; Mr. W. H. M. Christie; Lieut. N. Darwin, R.E.; Prof. E. Frankland, D.C.L., F.R.S.; Mr. H. F. Morley; Capt. R. G. Scott, R.E.; and Mr. Angus Weiss.

Mr. S. P. Thompson read a paper "*On the Chromatic Aberration of the Eye in Relation to the Perception of Distance.*" He discussed the various means of estimating distances by the eye, showing that when data for forming a judgment by the associations of visible form or visible magnitude fail, the judgment is founded on "aërial perspective," or else upon the muscular sensation of adjustment to focus. As the eye is, however, not achromatic, it cannot be in focus at the same time for red rays and blue rays proceeding from one object, but may be in focus if the blue rays come from a more remote object. This gives a definite basis to the axiom of painters that blue is a "retiring" and red an "advancing" colour. Experiments were described demonstrating the truth of this fact, and illustration was afforded of the chromatic aberration of the eye by casting beams of light through a solution of permanganate of potash upon a silvered ball, the illu-

minated point appearing red with a blue surrounding halo to an eye adjusted to short focus, but blue with a red halo to long focus.

Prof. Guthrie referred to the theory by which the apparent size of an object depends on the amount of nervous excitement which it occasions, whether this be due to the extent of the illuminated area or the intensity of its illumination, and he pointed out that an object always appears larger when looked at with two eyes than with one eye.

Mr. Roberts drew attention to the fact that the system ordinarily adopted in mechanical drawing, of assuming the light to fall from the left-hand top corner, gives an appearance of solidity, whereas if this be reversed, and the light falls from the right-hand bottom corner, the object appears hollow.

The President referred to the well-known fact that if two stereoscopic pictures are taken representing the same object in complementary colours, most people have a great difficulty in combining them so as to see a single picture of a neutral tint.

Mr. S. P. Thompson then described a curious observation of change of pitch occurring when a tuning-fork is caused to rotate rapidly round its axis, the nodal interferences at each quarter rotation ceasing to be separately heard when recurring more than about thirty times in a second. He has attempted various ways of estimating he amount of this change of pitch, including a method ounded on the binaural estimation of interference beats.

AKADEMIE DER WISSENSCHAFTEN, VIENNA.

April, 1877.

J. Donath, "*Decomposition of Hydroxylamine by Alkaline Cupric Solutions.*" Reduction to cuprous oxide, accompanied by a lively development of pure N_2O occurs even in the cold. Volumetric analyses coincided with the decomposition—

$$2NH_3O + O_2 = N_2O + 3H_2O,$$

from which fact the author considers that no hydroxyl group is contained in hydroxylamine, but that the oxygen united with the nitrogen solely."

H. Brücke, "*Contributions to Chemical Statics.*" Theoretical considerations, based on the action of various acids, at different temperatures, on the violet solutions of ferric salicylate.

J. Preluj, "*Diffusion of Vapours through Earthen Cells.*" The observations were made in a graduated tube, the sides of which were coated with soap solution, a disk of mica resting on a soap film serving to mark the changes in volume. Ether gave results varying from Graham's law. Chloroform yielded numbers closely coinciding with those reckoned from the theoretical specific density. Experiments conducted at various temperatures, when the air in the interior of the apparatus was saturated with aqueous vapour, showed that the velocity of diffusion of aqueous vapour is dependent on the temperature in the same degree as the maximum of tension. After determining the constant of an apparatus in dry air, an observation made in ordinary air would serve to determine the relative amount of moisture present.

A. v. Obermayer, "*Friction on Viscous Bodies.*" The inner friction of pitch is shown to be subject to the same laws as the friction of liquids. The inner friction of merely soft bodies varies notably from these laws.

P. C. Puschl, "*Latent Heat of Vapours.*" The author finds that if a mixture of vapour and liquid passes through the following series of changes,—viz., expansion by constant temperature, elevation of the temperature by constant volume, compression to the original volume by this elevated temperature, and cooling to the original temperature,—the external labour required is greater than the equivalent of heat so won. An inner labour is thus produced, which in some unknown manner escapes as the evolved heat.

Z. H. Skraup, "*On Super-Ferricyanide of Potassium.*" This body, already described by Städeler and Bong, but not analysed, on account of its unstable properties, was obtained by the action of HCl and $KClO_3$ on red prussiate of potassium. It is black, amorphous, easily soluble in water, insoluble in alcohol, and possesses the composition K_2FeCy_6. Fe must be regarded as tetravalent in this case.

R. Maly, "*A New Derivative of Sulpho-carbamid,*" This consists of sulpho-carbamid-acetic acid,—

$$CS.(NH_2)(NH.CH_2.COOH),$$

which can be regarded as a sulpho-hydantoic acid.

CORRESPONDENCE.

PRODUCTION OF CARBONIC ACID. DECOMPOSITION OF CARBONATE OF LIME.

To the Editor of the Chemical News.

Sir,—Allow me to refer briefly to a paragraph in your "Chemical Notices from Foreign Sources" (Chem. News, vol. xxxv., p. 188), in which is an interesting note on a "New Mode of Manufacturing Sulphides, Carbonates," &c., by Mr. C. Vincent.

It would be very interesting to know whether he has in practice produced a sulphide of potassium or sodium, in his new process, at a less cost than by the usual mode of calcining the sulphate with charcoal?

Probably he does not consider it new to displace H_2S by CO_2 so as to form a carbonate, as it has been used for many years, and is, in fact, the most elegant way of producing carbonate of ammonia direct from raw gas liquor; but, in an economic point of view, whence are we to obtain the CO_2? And it is this enquiry which induces me to refer to the article at all. He would confer a boon upon many manufacturers if he could indicate a practically cheap source of CO_2.

Alkali derive a limited supply from the saturation of their excess of HCl, but this is all required for making the bicarbonates of soda and potash. And of course it does not pay to liberate CO_2 for the purpose by any acid which has to be produced expressly for it.

There are probably hundreds of tons of CO_2 thrown off daily from our large breweries and distilleries, and much money has been spent in attempts to utilise it; but the collecting and purifying have always cost more than the available value. And the same remark applies to attempts which have been made to collect and purify the gases which escape from flues where CO is utilised as a source of heat, as in burning the gases of iron furnaces.

But an impression prevails that limestone gives off its CO_2 at a strong red-heat. In my experience this separation does not take place (as CO_2) at any temperature which fire-clay or iron retorts will bear.

Some years ago I erected a bench of ordinary iron gas-retorts for this purpose, but the resulting gas was nearly pure CO. I suspected this was caused by moisture in the limestone coming in contact with the heated iron, so as to liberate H, which reduced the CO_2 to CO; and I therefore selected very pure limestone,—in fact, marble,—and having powdered and dried it, no gas was liberated, although the heat was raised till the iron melted; but when I exposed portions of this same marble to H, at a moderate red-heat, I obtained at once a copious supply of CO. Carbonaceous matter mixed with the marble produced the same result, and this led me to examine the gases from lime-kilns, wherein coal is always intimately mixed or stratified with the limestone, and I found the gases to consist in every case almost entirely of CO. I therefore arrived at the conclusion (which I have never seen reason to alter) that no practically moderate temperature will liberate CO_2 from limestone unless some reducing agent be present, which of course renders it useless.

I was subsequently assured, by a rather high authority, that dry superheated steam, forced into vessels containing white-hot limestone, would permeate it and extrude the CO_2 unaltered. I tried this in fire-clay retorts of the best Stourbridge make, but with no better result; the gas I obtained was almost entirely CO.

I have also tried, at various temperatures, and under various circumstances, the combustion of coke, charcoal, and in a current of air, but the result was a mixture of CO with nitrogen, and but bare traces (of no practical use) of CO_2, resulting from the secondary combustion of the CO.

I shall therefore be greatly obliged to Mr. Vincent or any other of your correspondents if they will indicate some source of CO_2 sufficiently cheap to render this new mode of making carbonates practically useful.—I am, &c.,

Alfred Payne, F.C.S.

Galen Laboratory, Ettingshall, Wolverhampton, May 14, 1877.

BLOWPIPE TESTS FOR BORIC ACID.

To the Editor of the Chemical News.

Sir,—Whatever may be the cause of my want of success in using the test advised by Major Ross for boric acid, the deficiency of the heat employed had nothing to do with it, I think, as the experiments were made with a very powerful blowpipe-flame. The Bunsen burner was only used as an additional test of the permanence of the green colouration caused by copper. In his book Major Ross certainly speaks of the test as not being so effective as Turner's, but his allusion to it in the Chemical News (vol. xxxv., p. 99) does not convey the same impression, as he says—"The real defect of Turner's method is, that the reaction is too ephemeral. I have attempted to remedy this defect by the use of a solution of copper." It was this which first caused me, and probably others, to try the process, a good test for boric acid being so valuable in determinative mineralogy, &c.

I think Major Ross, in his letter (Chemical News, vol. xxxv., p. 187), sufficiently admits that the test is not a very good one, on the same grounds which I pointed out, viz., that he *begins* with a green colouration similar to that which is afterwards to form the proof of the presence of boric acid; and also by introducing soda solution to cover this first green. As he is about to give us a far better test, having nothing to do with flame-colouration, he can well afford the admission.

Using soda solution, as now advised, I find it, of course, easy to destroy the copper green; but I quite fail to produce any new colouration by the addition of tourmaline or axinite, even in considerable quantity. The soda (added a little at a time in dilute solution, till the copper-green is just completely obliterated) renders anything else (to me) quite imperceptible. I am well aware how different a coloured flame may appear to two people, especially when the colouration is not very intense, and this may be a case in point; but I fancy most people would find the soda-flame in this instance completely swamp all else. Indeed, if the soda is competent to destroy the copper-green, why not also the green which is to be looked for on adding borates? Turner's test overcomes the presence of an enormous sodium-colouration, because of the very great volatility of the boron-compound which is produced, and the sudden rush which this makes to the outer edges of the flame, enabling a small quantity of boron to produce an intense, though transient, effect. No similar reaction takes place in the test under discussion.

It is a great pity that a proper and efficient use of the blowpipe and accessories is not more widely taught. I have been informed that it is not taught at all at the Royal School of Mines. I can, however, hardly credit this, as, whoever could afford to do without this useful knowledge, the Mining Engineer—who may have to examine mineral deposits in all sorts of out-of-the-way places—could *not* (or *should* not) afford it. So much stress is laid upon it at the several Continental mining-schools that the one in Jermyn Street surely does not form an exception.

The very low opinion of "pyrology" which is held by many chemists and teachers cannot be wondered at by those who have had occasion to see the wretched, inefficient, and unsystematic "pottering" which frequently passes muster among chemists and mineralogists as "blowpipe-work," in spite of the excellent books to be had on the subject, and of the knowledge that so many distinguished men have found it worth while to give very great attention to the study, which is too often regarded as trivial and useless.

Many people will have noted with satisfaction that the announcement that the Society of Arts are going to award prizes for proficiency in blowpipe determination of minerals, the examination to be held in Cornwall, where very good instruction in the subject is being given to miners and others—surely a case of "the right thing in the right place."

I believe very many instances are well known of deposits of great value being neglected, or passed over, by those in charge of mines, because they had no means of recognising what was before them. I have myself had very many instances under my notice of the converse of this, viz., the mining and shipping to this country of large quantities of ore, either utterly valueless or valuable only in a far less degree than was expected, simply because the people at the mines had been deceived by appearances, had had no means of testing, and had not waited, or gone to the expense of having samples sent for assay before so mining and shipping. Heavy losses take place in this way when large quantities are mined and sent to the coast at great cost, and are sent here by steamer many thousands of miles. In all the many cases known to me the mistakes would never have occurred if anybody at the mines had ever had a few lessons in "blowpipe," and possessed such apparatus as would cost, at the outside, £2 or £3.

Surely such considerations as these are eminently "practical," and should argue strongly for the regular and systematic teaching of the use of the blowpipe, at all events in mining-schools and similar institutions.—I am, &c.,

W. M. Hutchings.

Laboratory, Wallasey Ore Works, Birkenhead, May 12, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 17, April 23, 1877.

This issue is taken up with the prizes annually awarded at the Public Session of the Academy. The Bordin prize in physics for the best paper on the true heat of the sun's surface was not awarded. The Jecker prize in chemistry was given to M. Cloëz for his late researches on the oil of the seeds of *Elæococca vernicia*. A subordinate Desmazières prize of 500 francs was awarded to M. Müntz for his researches on the nature of the sugars which enter into the constitution of fungi and on the respiratory functions of these plants. The Montyon prize for combatting the evils of the insalubrious arts was given to Prof. Melsens for his successful introduction of the iodide of potassium as a remedy for saturnine and mercurial poisoning. The Gegner prize has been awarded to M. Gaugain for a set of researches, among which we mention

his memoirs on the thermo-electric action of tourmalines, on thermo-electric couples, his examination of electric condensers, and of the propagation of electricity in conductors of a medium quality.

Biedermann's Central-Blatt fur Agricultur Chemie, Heft 2, 1877.

The Drinking Waters of Königsberg.—M. Beer.—The author has determined suspended matter, solid residue, total hardness, permanent hardness, lime, magnesia, chlorine, sulphuric, nitric, and nitrous acids, and quantity of permanganate required for the oxidation of organic matter. The waters contain "putrefaction-organisms," and are pronounced offensive in odour and ill-adapted for dietetic use.

Arable Soils of Auvergne.—Prof. M. Truchot.—The main element of the fertility of these volcanic soils is phosphoric acid, which occurs combined with lime. The quantity of nitrogen existing in the soils is in a direct relation to the carbon of the ulmic substances present. It must therefore be assumed with Dehérain that atmospheric nitrogen combines with these carboniferous compounds before it is capable of co-operating in the nutriment of plants.

Formation of Urea in the Animal System.—Dr. Drechsel and Dr. F. Hofmeister.—Dr. Drechsel believes that he has detected carbamic acid or one of its salts in the serum of dogs' blood, and infers that from this body urea is formed by the action of a ferment. Dr. Hofmeister considers the presence of carbamic acid not proved by the reactions given.

Substitution of Gelatin and Tyrosin for Albumen in Diet.—L. Heumann and Theodor Escher.—The author finds that in the absence of albumen gelatin and tyrosin conjointly are capable of supporting the organism, though neither of them taken singly has that power.

Experiments on Plants with Coloured Light.—Prof. G. Kraus.—On prolonged exposure plants in blue light appeared of a deeper green than those placed in yellow light. Still phycocyan and diatomin were formed under the influence of yellow light. The injurious action of green light upon the mimosa was confirmed.

Signification of Chlorophyll.—Dr. R. Sachsse.—The author regards chlorophyll as the first stage in the formation of starch.

Xanthophyll and Chlorophyll.—Dr. R. Sachsse.—If an alcoholic solution of chlorophyll is many times shaken up with so-called light benzin from petroleum and the upper stratum is each time drawn off, at last a pure yellow solution is obtained—the xanthophyll of Krause.

Para-arabin.—Prof. E. Reichardt.—This substance, $C_{12}H_{22}O_{11}$, is obtained from the tissues of the sugar-beet or the carrot after the juice has been expressed. It gelatinises with water, and dissolves completely on the addition of a little acid and the application of a gentle heat.

Difference in Genuine Milks.—Prof. E. Reichardt.—The author finds that the difference between the respective amount of "solids not fat" in the richest and poorest samples was 1·72 per cent.

Detection of Oleo-Margarin in Butter.—Prof. G. Lechartier.—Fresh genuine butter which has not been melted appears under the microscope composed of ovoid granules, and contains no crystals. The artificial product obtained from tallow contains crystals. Artificial butter does not melt at once, like genuine butter, to a clear oil, but fuses gradually, a whitish "sauce" being first formed.

Adulteration of Bread and Flour with Gypsum, Heavy Spar, &c.—Dr. Erdmann and Dr. Vohl.—A Rotterdam firm has been recently offering finely ground gypsum to various millers in the province of Hannover. To detect such frauds Vohl mixes 10 grms. of the flour with 20 grms. of potash saltpetre, places the mixture in a platinum vessel, and ignites with a red-hot platinum wire. If the flour is pure the pale green melted mass dissolves almost entirely in water, and the solution, scarcely turbid, gives no precipitate with hydrochloric acid, which, if it appears, indicates the presence of silicates. The acidulated solution should give with barium chloride merely a slight turbidity. A decided precipitate indicates the presence of sulphate of lime or of baryta.

MISCELLANEOUS.

Blowpipe Apparatus.—A prize of £10, which has been placed at the disposition of the Council by Colonel A. A. Croll, is offered by the Society of Arts, with the Society's Silver Medal, for the best set of Blowpipe Apparatus which shall be sold retail for one guinea. The apparatus must, at least, contain blowpipe, blowpipe lamp or candle, spirit lamp, charcoal or charcoal pastilles and holder, platinum wire, glass tubes closed at one end (mattrasses), open glass tubes, platinum-tipped forceps, magnet, hammer and anvil, and four reagents, viz., borax microcosmic salt, carbonate of soda, and nitrate of cobalt. These instruments and reagents, together with any other which may be thought desirable, must be packed in a box. It must be understood that the above list of apparatus, &c., is only intended to include such as are absolutely indispensable, and it is expected that the set will contain additional instruments and reagents, the selection of which is left to the competitors. Special attention should be paid to the following points:—1. Solidity of construction. 2. Compactness and portability. 3. Facilities for packing and unpacking. 4. Number of useful instruments and reagents in addition to those mentioned. The Society does not engage to give the prize unless some apparatus apyears to show sufficient merit, and some advance on what is now obtainable for a guinea. All apparatus for competition must be sent to Society's House on or before 1st August, 1877. The successful competitor must guarantee that a proper supply of the apparatus shall always be kept on hand, for sale in England.

MEETINGS FOR THE WEEK.

Tuesday, 22nd.—Royal Institution, 3.
—— Civil Engineers, 8.
—— Anthropological Institute, 8
Wednesday, 23rd.—Society of Arts, 8. "The Measurement and Settlement of Musical Pitch," by A. J. Ellis, F.R.S., F.S.A.
—— Geological, 8.
Thursday, 24th.—Royal Institution, 3. "Heat," Prof. Tyndall.
Friday, 25th.—Royal Institution, 9. "Evolution of Nerves," Mr. G. J. Romanes.
—— Quekett Club, 8.
Saturday, 26th.—Royal Institution, 3. "Modern French Poetry," Mr. W. H. Pollock.
—— Physical, 3. "On the Friction of Water and other Liquids," and "On Ice as an Electrolyte," by Profs. J. Perry and Ayrton. "Spectroscopy," by H. Col. Campbell.

ROYAL INSTITUTION OF GREAT BRITAIN,
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Professor JAMES DEWAR, M.A., F.R.S.E., will on TUESDAY next, May 22nd, at Three o'clock, begin A COURSE OF THREE LECTURES "*On the Chemical Philosophy of Sir Humphry Davy.*"—Subscription to this Course, Half-a-Guinea; to all the Courses in the Season, Two Guineas.

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THE CHEMICAL NEWS.

VOL. XXXV. No. 913.

ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

125. In my previous papers on this subject† the experiments described have had for their object the demonstration of the broad facts of repulsion resulting from radiation. In Part I., after satisfying myself that the action was not due to air-currents or electricity, I went rapidly over bodies of the most diverse chemical and physical characters, organic and inorganic, metallic and non-metallic, dense and light, in spheres, disks, and thin plates, endeavouring to find, from their behaviour when free to move in a vacuum, what conditions were necessary to obtain the strongest movement under the influence of radiation, and what were unnecessary. I ascertained that chemical constitution had little or nothing to do with the action. I said (par. 75) "the law appears to be that the force exerted is in proportion to the extent of surface exposed, rather than in proportion to the mass. Much surface and extreme lightness are the requisites in selecting materials for the beam, index, or gravitating mass; and when the masses have the same specific gravity and extent of surface, their position in respect to the source of heat determines the extent of movement. Thus a cylinder of pith is more sensitive when arranged for the heat to act on its side than on its end." I tried many experiments on the circumstances governing the position of the neutral point during exhaustion, and I proved that, within experimental limits, the nearer the vacuum approached perfection the stronger was the movement due to radiation.

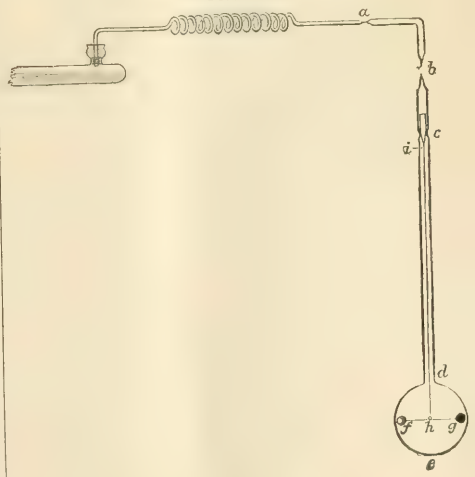
In Part II. I described many improved forms of apparatus by which the movements due to radiation could be studied in a more complete manner and numerical results be obtained; the action of the various kinds of radiation, from the obscure heat-rays emitted by copper at 100° C. to the blue and ultra-violet rays of the spectrum, was examined, the interference caused by passing the rays through various screens was shown, and the phenomena of the neutral point were further discussed. Experiments were described which satisfied me that the hypothesis of the movements being due to evaporation and condensation at the surface would not account for all the facts of the case; and ample proof was afforded that "to get the greatest delicacy in these apparatus there is required large surface with a minimum of weight," an apparatus for the quantitative examination of this law being described.

126. Nearly all the experiments described in Parts I. and II. were made with the dark or slightly luminous heat-rays—the fingers, a hot glass rod, hot copper, or a candle-flame being used as the source of radiation. I quote the following sentence from par. 94:—"Although I most frequently speak of repulsion by *heat*, and in illustrating any of the results obtained I generally use either the fingers or the flame of a spirit-lamp as a convenient source of radiation, it must be clearly understood that these results are not confined to the heating-rays of the spectrum, but that any ray, from the ultra-red to the ultra-violet, will produce repulsion in a vacuum. I have already mentioned this fact in my first paper (58, 68)."

A few experiments were tried on the effect of radiation on surfaces the reflecting or radiating power of which was modified by coating them with various substances. In par. 102, after describing a torsion-apparatus for quantitative work, I mention that the surfaces of pith, as thin as possible, may be coated with lampblack or silver, or may retain their natural surface; in par. 108 I state, as the result of a long series of experiments with this apparatus, that "the conducting-power for heat and condition of the surface (whether coated with lampblack or consisting of polished metal) of the body on which radiation falls materially influence the movements." In par. 112 I again refer to the effect caused by the physical condition of the surface; and further on, in par. 116, I say, "A series of experiments have been tried with a view to ascertain what influence the state of the surface of the substance submitted to radiation has on the amount or the direction of its movement." After describing one in which white ivory was compared with lampblacked ivory without giving very striking results, I continue:—"These experiments were, however, tried in 1873, when I had not succeeded in getting anything like the delicacy I now obtain in the apparatus; and I propose to repeat them under varied conditions, before employing the results to found any arguments upon."

The present paper contains an account of these experiments on the action of radiation on bodies the surfaces of which have their radiating and absorbing powers modified by various coatings. The surfaces examined in this way are of the most diverse character, the incident rays have been selected of all refrangibilities from ultra-red to ultra-violet, the radiation has been sifted through liquid, solid, and gaseous screens, the degree of exhaustion and the sensitiveness of the apparatus have been brought to a state of perfection undreamed of in my earlier experiments, and the results, I venture to state, are of a correspondingly striking character.

FIG. 1.



127. The results which I obtained on comparing the action of radiation on thin substances, plain and lampblacked, were at first very anomalous. As already stated (116) the movement of lampblacked ivory under the influence of radiation was only a little more than that of plain white ivory. On the other hand, coating platinum with lampblack produced a very marked effect on its movement (114).

Pith coated with lampblack was generally found to have

* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

† *Philosophical Transactions*, vol. clxiv. (for 1874), p. 501, and vol. clxv. (for 1875), p. 519.

its sensitiveness heightened; but this was not always the case, and the following experiments were tried for the purpose of clearing up these discrepancies.

128. An instrument was made similar to the one described and figured in pars. 84, 85, consisting of a glass bulb on the end of a tube, and having suspended in it, by means of a silk fibre, a horizontal glass stem with a disk of pith at each end. For a detailed description and the mode of exhaustion I refer to my last paper, the only point of difference being that in the present case one of the pith disks was coated with lampblack, the other remaining white.

Before exhausting the apparatus I found that the white and the black disk were attracted about equally by the fingers, a bulb of warm water, or a hot glass rod.

After exhausting it I tried the action again. The fingers repelled either disk strongly, and in about an equal degree; and the same result was obtained with other sources of heat of low intensity. If the finger, a bulb of warm water, or a warm piece of glass or metal is held for some time close to the glass bulb, the two disks are repelled, and the rod connecting them sets equatorially, showing that the repulsion is equal on the black and the white surface.

The bulb of water with enclosed thermometer (28) was raised to 100° C., and brought close to the bulb of the apparatus. The black and white disks were equally repelled, the connecting-rod setting equatorially.

A bath of fusible metal was prepared. In this a small copper ball was heated to different temperatures, and the action on the black and white disks noted.

At 100° C. the repulsion of the two was equal.

150° ,, ,,

200° ,, ,,

250° ,, ,,

300° the black was slightly more repelled than the white disk, the rod setting about five degrees from the equatorial position.

The fusible metal bath was gradually increased in temperature up to dull redness, and the action of the copper ball heated in it was tested from time to time; the temperatures were not ascertained, as they were above the boiling-point of mercury. The repulsion of the black disk increased until at dull redness the copper ball caused the rod joining the two disks to make an angle of about 40 degrees. At a full red heat the ball repelled the black disk very strongly, causing the rod to oscillate violently, and sometimes even to pass the axial position.

129. A candle brought near the apparatus acted on the disks even more energetically than the red-hot copper. At a little distance off the movable rod set at an angle of 45 degrees; and by causing the candle to approach or recede, the angle formed by the rod varied in a corresponding manner, the torsion of the suspending fibre balancing the varying force of radiation.

130. During the exhaustion of one of these pieces of apparatus, an action of aqueous vapour was observed which explained some of the anomalies I had met with in the course of this investigation. The apparatus had a little water in it; and although the mercury-pump brought the gauge to within about 8 millims. of the barometric height in the course of ten minutes, the tension of the aqueous vapour prevented it from rising higher. After working the pump for several hours, and gently warming the different parts of the apparatus, the liquid water was evaporated, and only aqueous vapour remained. The gauge now rapidly rose to the height of the barometer, the apparatus necessarily being filled with the residual aqueous vapour. On bringing a lighted candle near the disks I expected to see the black one violently repelled; but instead of that the connecting-arm set equatorially, showing that the radiation from the candle within a few inches of the disks repelled the white one as strongly as it did the black. The pump was kept in action, and oil of vitriol was passed through it once or twice (44). This was continued for about four hours; and on testing the apparatus from time to time with a candle the repulsion of the black disk gradually increased, the arm setting at a greater and greater angle from the equatorial position, but at no time getting very strongly deflected.

An accident happening to one of the tubes of the pump, it was necessary to let air into the apparatus; it was passed in slowly over oil of vitriol. As soon as the pump was mended exhaustion of the apparatus was recommenced. As soon as the gauge rose within 6 millims. of the barometric height the candle was seen to repel the black disk. At 3 millims. the superior repulsion of the black over the white disk was sufficient to cause the arm to set 45°; and as the exhaustion got better the repulsion of the black disk increased, until at the point when the gauge and barometer were level the candle exerted a strong action many feet off, and when brought close to the instrument set the bar and disks in most violent agitation, the black disk being driven violently away, and the connecting-arm swinging rapidly on each side of the axial position.

This experiment shows that the presence of even a small quantity of aqueous vapour in the exhausted apparatus almost, if not quite, neutralises the more energetic action which luminous rays appear to exert on a blackened surface. In the first case, even when the gauge and the barometer were appreciably level, and the pump had been working for some hours, the superior repulsion of the black over the white was not so strong as it was in the second case when the gauge was several millims. below the barometer.

131. These two experiments, the one showing a marked difference of action on a black surface between heat of low intensity and luminous rays, and the other showing that this difference may be neutralised by aqueous vapour, explain most of the anomalies I have met with; and especially they prove how it was that my earlier experiments with black and white surfaces failed to show much difference. They also prove that still further improvement in the vacuum-producing apparatus would be advisable. I accordingly adopted Dr. Angus Smith's and Professor Dewar's plan of absorbing the residual gas by means of cocoanut-shell charcoal; and I found that after a little experience this, although somewhat tedious, left little to be desired in the perfection of the vacuum. A glass tube about 6 inches long is tightly packed with small pieces of freshly ignited cocoanut-shell charcoal; it is then drawn narrow at each end and sealed on to the apparatus, between it and the spiral glass tube.* The exhaustion proceeds as usual till the gauge and barometer are appreciably level; the charcoal-tube is then heated to a temperature well within the softening-point of the glass, when the occluded gases are given off from the charcoal and depress the mercurial gauge 30 to 40 millims. The pump is now worked rapidly until the gauge is brought up again; the heating of the charcoal is repeated, when more gas is given off and the gauge is again depressed, although not so much as before. The pump is again set going, and these operations are repeated until heating the charcoal ceases to depress the gauge. The effect of this has been to repeatedly wash out the residual atmospheric air and aqueous vapour from the interior of the apparatus, and replace it by gas or vapour which has been occluded by the charcoal, and which we are justified in supposing will be again occluded by it even when very highly exhausted. When these operations are finished, and no more gas is carried down by the mercury, the apparatus is removed from the pump by sealing off the tube at the narrow part between the charcoal and the spiral, so as to leave the charcoal still in connexion with the apparatus. The two together are now set aside for some weeks, when the charcoal will gradually absorb the whole of the residual gas and leave the vacuum so nearly perfect that it will not conduct an induction-current of electricity. In most of my experiments this refinement is not necessary; but in some, especially when working with the ap-

* In some of the subsequent woodcuts of apparatus (135, 145) this charcoal-tube is shown in its place.

paratus subsequently described, I prefer to adopt it. When it is considered that the charcoal has exerted its full action the tube containing it may be drawn off before the blow-pipe, and the apparatus left ready for use.

(To be continued.)

NOTE ON THE CHEMICAL RELATIONS OF FRANKLANDITE AND ULEXITE.

By J. EMERSON REYNOLDS, M.D.,
Professor of Chemistry, University of Dublin.

A SHORT "Note" on this subject by Professor How appeared in the CHEMICAL NEWS, vol. xxxv., p. 189, in which the formula for ulexite is stated to be different from that which I adopted, for the purpose of comparison, in a recent paper on Franklandite. The latter mineral is a new borate which I described and named after Dr. Frankland. The empirical formula of the body proved to be—

$$2Na_2O,2CaO,6B_2O_3,15H_2O.$$

The object of my paper was, of course, to describe the new compound, but, having done so, I pointed out that it seems to be related to the mineral ulexite in a very simple way, if we employ for the latter the empirical formula—

$$Na_2O,2CaO,6B_2O_3,18H_2O.$$

That expression was used on the authority of Rammelsberg, but I was well aware of the fact that the formula had been called in question by Professor How and others, who found for a mineral believed to be ulexite the ratios—

$$Na_2O,2CaO,5B_2O_3,15H_2O.$$

It is evident that How's formula for ulexite would serve my purpose quite as well as Rammelsberg's, for in either case the chemical relations of Franklandite and ulexite are easily recognised. I found, however, that Dana, in his excellent "System of Mineralogy," seems to give the preference to Rammelsberg's formula; as he has not only placed it before Professor How's, in the descriptive portion of the work, but he has also selected it for translation —at p. 595 of the 5th edition—into the new and peculiar notation first generally applied to minerals by Dana in that particular edition of his great work. It is just possible that the minerals analyed by Rammelsberg and by How, were not, strictly speaking, identical, as these mineral borates resemble each other very closely in physical characters; hence I did not think that it would be desirable to enter ints a discussion upon points which could not be settled without a good deal of investigation, and which, moreover, did not directly concern me. I then decided to employ Rammelsberg's formula for ulexite, as that expression is evidently still considered worthy of confidence by the distinguished author of our chief mineralogical work of reference.

Dublin, May 14th, 1877.

DETERMINATION OF CHROMIUM BY STANDARD LIQUIDS.

By MM. FERD. JEAN and H. PELLET.

By the employment of baryta water and standard sulphuric acid we can determine easily and rapidly the chromic acid in chromates, bichromates, insoluble chromates, and titrate chrome iron.

Theory of the Process.—If to a neutral solution of an alkaline chromate we add baryta water there is formed—

(1.) Insoluble chromate of baryta, the alkali originally combined with chromic acid becoming free.

(2.) On precipitating the excess of baryta by carbonic acid, boiling, to render insoluble the carbonate of baryta, and filtering, the liquid contains in the state of carbonate all the alkali which was combined with chromic acid.

(3.) From the quantity of sulphuric acid necessary to saturate the alkali set free by the baryta we may deduce the corresponding chromic acid.

Practice of the Process.—The theory which we have just indicated is applicable to the determination of chrome in a great number of cases. The solutions upon which we can operate ought to be free from acids precipitating baryta or salts of which the base gives with carbonic acid a precipitate. We will take, for example, the titration of a chromated iron.

The ore is reduced to a very fine powder, then dried. We put 1 grm. of the sample into a silver capsule containing from 12 to 15 grms. of pure melted soda. We heat to redness for fifteen to twenty minutes. When the ore has been sufficiently pulverised the attack is complete with the first operation. We treat with water, which leaves a residue consisting especially of oxide of iron.

If the attack of the ore is not complete we should dissolve the insoluble part by the aid of hydrochloric acid to separate the oxide of iron from the chromated iron not attacked, and we effect a second fusion of the residue with 2 or 3 grms. of pure soda.

All the waters containing the alkaline chromate are mixed, and evaporated so as to form a volume of 400 c.c. We neutralise the liquid almost entirely with some cubic centimetres of concentrated and pure hydrochloric acid, but we leave a slight alkalinity, which we recognise by the yellow lemon-colour which the liquid possesses. We make up the volume to 500 c.c., and we filter it if needful.

Take 250 c.c. of the filtered liquid, and saturate exactly with dilute hydrochloric acid (50 to 60 grms. per litre). To arrive easily at this point of neutralisation, we can operate according to one of the methods below:—

(1.) Put into the 250 c.c. a few drops of litmus, and saturate at a boil with diluted hydrochloric acid.

(2.) We may also pour in the acid until a drop of the liquid tried upon litmus or turmeric paper indicates exact neutrality. To the neutral liquid we add 50 c.c. of a solution of pure baryta, and then seltz water; we boil for a quarter of an hour to drive off the excess of carbonic acid. When the solution is cooled we add water so as to make up a volume of 500 c.c., then we filter, and we titrate the alkaline carbonate in 200 c.c. of the clear liquid by the aid of standard sulphuric acid. The sulphuric acid may have any standard; nevertheless, to facilitate the calculation, we have made use of the following liquids:—Acid solution containing 12·58 grs. of SO_3HO per litre. 100 c.c. of this acid correspond to 0·25 grm. CrO_3KO.

If we suppose that in the example below we had employed 11·8 c.c. of standard acid we shall have the following calculation:—

a. 10 c.c. standard $SO_3HO = 0{\cdot}25$ grm. CrO_3KO
11 . . $\times = 0{\cdot}295$ CrO_3KO.

b. If 250 c.c. alkaline liquid $= 0{\cdot}295$ CrO_3KO,
550 c.c. . . $= \times = 0{\cdot}590$ CrO_3KO.

c. If 250 c.c. of the chromate liquid $= 0{\cdot}590$ CrO_3KO,
500 c.c. (or 1 grm. of ore) $= 1{\cdot}18$.

100 grms. of the ore tried will furnish, then, 118 per cent of the chromate of potash.

We shall remark that the concentration of the acid which we have just indicated is such that the number of c.c. of the acid solution employed gives at once, accordingly, the proportion of chromate of potash.

(2.) Acid solution containing 16 per cent of sulphuric acid. The acid prepared in this proportion is such that the number of c.c. of acid employed, for the volumes which we have indicated, corresponds to the proportion of sesquioxide of chrome contained in 100 parts of the ore, but as the sensibility of the process may be diminished by the use of an acid too concentrated, we shall prefer to prepare it in the proportion of 8 grms. per litre.

In operating under the conditions above mentioned, the

figure found on the burette, divided by 2, gives the weight per cent of the sesquioxide of chrome contained in the normal matter. To simplify the calculation we employ two coefficients :—

Sesquioxide of chrome × 2·545 = chromate of potash.
Chromate of potash × 0·3926 = sesquioxide of chrome.

Remarks.—(1.) The volume of chromate of baryta and carbonate of baryta is very small; we have satisfied ourselves that there is no occasion to take it into account.

(2.) The soda and the hydrochloric acid ought to be free from sulphuric acid, phosphoric acid, and salts of lime.

(3.) The addition of the sulphuric acid ought not to produce any turbidity; if this takes place the assay must be re-commenced, for the boiling cannot have been prolonged enough to render insoluble all the carbonate of baryta.

(4.) The baryta may contain a certain quantity of alkalies. We ought to ascertain the purity of this base before making use of it, and in case of need to establish the correction to be made for a certain volume of baryta water.

The assays which we have made to study this process of titrating chrome have given us good results. In 39·28 of chrome in a state of sesquioxide we have found 38·89, and out of 0·346 of bichromate of potash, 0·343 gr.

This process is applicable to the assay of insoluble chromates when they are decomposable by fusion with alkaline carbonates. The chromate of lead being not clearly decomposed into carbonate of lead and alkaline chromate, and the alkaline liquid always holding lead in solution, our process is not convenient for the assay of this salt.—*Bull. de la Soc. Chim. de Paris.*

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 189.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

In the Chemical News† the proposal of P. W. Hofmann, to which reference has been made, has been discussed at length by Gibbins, Peter Spence, and others, and the process has been already experimentally introduced into certain German establishments. In 1867 Winckler‡ published some interesting investigations on the chemical processes which take place in the Gay-Lussac condensing towers. The following conclusions may be drawn from his experiments :—

a. Nitric oxide is not absorbed by hydrated sulphuric acid.

b. Hydrated sulphuric acid combines with nitrous acid energetically and with the evolution of heat. The compound is intimate and truly chemical; it is not decomposed by a considerable elevation of temperature, but is immediately broken up on the addition of water. In the manufacture of sulphuric acid this compound is formed in a solid state in the so-called chamber crystals, whilst it is met with dissolved in a liquid state in the sulphuric acid flowing out of the coke towers of Gay-Lussac's apparatus. Nitric oxide and oxygen do not in in presence of hydrated sulphuric acid combine as usual to form hyponitric acid, but form nitrous acid, even when the oxygen is in excess.

c. Hyponitric acid both in the liquid and the gaseous condition is capable of combining with hydrated sulphuric acid. The compound, however, if truly chemical is very unstable. On the application of heat it is completely decomposed, and the hyponitric acid either escapes unchanged or is resolved into nitrous acid, which enters into chemical combination with the sulphuric acid, and into oxygen which is set free. The mode of decomposition depends on the degree of concentration of the sulphuric acid.

d. Sulphuric acid and nitric acid appear to form mere mechanical mixtures, which, when heated, are resolved into escaping nitric acid, oxygen gas, and nitrous sulphuric acid.

e. Nitrous sulphuric acid in presence of moisture form, on contact, hydrated sulphuric acid, while nitric oxide gas is evolved.

f. Hyponitric acid, in contact with moist sulphurous acid, forms nitrous sulphuric acid in a solid crystalline state.

Ten years ago most sulphuric acid works were unprovided with the Gay-Lussac tower for absorbing the nitrous acid which escapes at the end of the lead chambers. In many cases such a tower had been erected, but was not in use. Gay-Lussac, along with Lacroix, introduced his process at Chauny, in the department of Aisne, as early as 1842 in order to absorb the nitrogen compounds escaping from the chambers in concentrated sulphuric acid, and thus to make them capable of re-utilisation. These experiments were undertaken, therefore, at a time when the acid was prepared almost exclusively from sulphur. In establishments where sulphur is in use the evolution of the gas is generally regular, and hence at that time the results obtained were satisfactory as regards the consumption of nitre. On the introduction of pyrites, especially when the original and very imperfect kilns were employed, the influx of gas became less regular, and the process in the chambers became thus liable to manifold disturbances. Gay-Lussac's apparatus therefore began to yield bad results. At the present day, since Gerstenhöfer and Schwarzenberg have calculated the composition of the kiln gases theoretically most advantageous, since we have learned to check over the composition of the gases by a simple determination of the sulphurous acid, and since more light has been thrown upon the whole process of the formation of sulphuric acid by the researches of Weber and Winckler, a regular production of gas is obtained from the pyrites kilns. The apparatus of Gay-Lussac was therefore introduced at Freiberg in 1865, and has been so managed that the results surpassed everything previously known as concerns the consumption of sulphuric acid. Gerstenhöfer has the merit of contributing to these successes and of circulating the experience obtained at Freiberg. At Aussig, Liesing, Hautmont, Berlin, Brussels, Griesheim, Hanover, Stolberg, and elsewhere, Gay-Lussac towers on the Freiberg pattern have been introduced. Since regular determinations of the sulphurous acid in the kiln gases have been made on Reich's method, and since the tower acid from Gay-Lussac's apparatus has been regularly tested for nitrous acid as proposed by Winckler, a new era in the manufacture of sulphuric acid has opened. The details of the apparatus as at first used in Freiberg have been given by Schwarzenberg,* who also describes the wheel, first employed by Segner at Aussig for the regular moistening of the coke in the towers.

The decomposition of the nitrous sulphuric acid was formerly effected by steam in a so-called "boiling drum." As this apparatus requires frequent repairs in some establishments the nitrous sulphuric acid is allowed to flow together with water in cascades of earthen vessels placed within the chamber, when the decomposition takes place. Recently Glover's tower, which will be described in the next section, has been used for this object

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* "Berichte uber die Entwickelung der Chemischen Industrie Wahrend des Letzten Jahrzehends."

† Chemical News, 1870, pp. 106, 132, 141, 164, 189, 200, 212, 224.

‡ Winckler, in the work cited.

* "Handbuch der Chemischen Technologie," von P. Bolley 2 Band, 1 Gruppe, von Dr. P. Schwarzenberg.

with the best results. A mixture of chamber acid and nitrous sulphuric acid flows from Gay-Lussac's apparatus down into Glover's tower. The hot kiln gases enter from below and concentrate the sulphuric acid to sp. gr. 1·7. The aqueous vapours thus evolved with the aid of the sulphurous acid decompose the nitrous sulphuric acid so completely that the concentrated acid from Glover's tower is perfectly free from nitrogen compounds, whilst the decomposition in the boiling drum and with the cascade can hardly be so conducted, but that imperfectly decomposed acid now and then escapes.

As regards the construction of the chambers opinions vary concerning the most advantageous form. A. W. Hofmann,* in the Report of the London Exhibition pronounced the formation of sulphuric acid independent of surface action, a view confirmed by the experience of many old manufacturers. Stass† has also proved by experiments at the chemical works of De Hemptine, at Brussels, that, other conditions being equal, the formation of sulphuric acid is proportional to the volume of the chambers. Smith,‡ in the pamphlet which we have repeatedly quoted, maintains that the interior of the chambers is a still unexplored land, and as a contribution to its exploration he gives some interesting statements as to the proportion of sulphurous acid, nitric acid, and sulphuric acid present in the chamber gases. Among other points he finds that the formation of acid is greatest in the vicinity of the acid already formed, and considers himself justified in concluding that the best shape for chambers is a height of 3 metres, a width of 9, and a length of 60. The author has not found the views of Smith to hold good. He suspended leaden capsules of equal sizes at different heights in the chambers covered with lids at the height of 30 c.m. from each, and determined the amount of sulphuric acid formed in each in an equal time.

Smith has probably drawn gases out of the chamber by aspiration, and determined the sulphuric acid therein. It is plain that even if sulphuric acid is formed equally in all parts the samples drawn below must contain a larger proportion of acid, since that which is formed in the higher part of the chamber must fall downwards. Smith seems, therefore, in this case not to have drawn the right conclusion from his observations.

(To be continued.)

* A. W. Hofmann, "Reports by the Juries," p. 99.
† A. W. Hofmann, "Reports by the Juries," p. 14.
‡ Smith, "Chemistry of Sulphuric Acid Manufacture," p. 22.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 17, 1877.

WILLIAM CROOKES, F.R.S., &c., Vice-President, in the Chair.

THE minutes of the previous meeting having been read and confirmed, the chairman announced that an Extraordinary General Meeting would be held on May 31 at 8 p.m. in the Society's Room.

Mr. TRIBE gave notice that at this meeting he would move the following resolution :—"That this Society is of opinion that the present system of election to its fellowship does not promote its interests or sustain its dignity, and that in place of this system the Council of the Society should recommend to the Fellows annually not more than twenty of the more meritorious candidates for election to its Fellowship."

The following certificate was read for the first time: F. H. T. Allan.

The following papers were then read by the Secretary, Dr. ARMSTRONG :—"*On a Slight Modification of Hofmann's Vapour Density Apparatus*," by M. M. P. MUIR and S. SUGUIRA. The original apparatus consisted (*Deut. Chem. Ges. Ber.*, ix., 1304) of an ungraduated barometer tube which could be closed under mercury at its lower end by a caoutchouc plate, when the level of the mercury, which is of course depressed until the whole of the liquid under examination is converted into vapour, remains constant; the apparatus is then allowed to cool, and the height of the mercury marked by a slip of gummed paper. The tube is now displaced and the amount of mercury necessary to fill the tube to the paper mark weighed. The authors propose to omit the closing with the india-rubber plate and to read off the height of the mercury by a cathetometer, when the tube has cooled sufficiently, by means of the cathetometer, a piece of gummed paper is placed at the exact level at which the meniscus stood. The authors do not claim absolute accuracy, but quickness and facility for the method; thus, with isoheptane the theoretical number is 50, by experiment 48·3 was obtained; and with terpene from sage oil, 68 theory and 67·5 experiment.

"*Note on the Fluid contained in a Cavity in Fluor-spar*," by J. W. MALLET, Virginia. The author possessed a specimen of green fluor from Alston Moor, containing a cavity of considerable size with fluid contents and a readily mobile bubble. The largest crystal was 14 m.m. on the side; the cavity is irregular and flattened, about 6 m.m. by 2·5 m.m. and 1 m.m. deep. On gradually heating the mass to 150° C. the bubble increased in size and lost its mobility; on cooling the bubble required a sharp jerk to make it change its place. Under the microscope the crystal after heating showed signs of incipient splitting. No viscidity was observed in the liquid after heating. In all probability the liquid was water.

Professsor CHURCH remarked that he had examined a crystal of fluor-spar resembling very much the one mentioned in the paper; in it there was a cavity containing some liquid and a mobile bubble. On heating it below 100° C. the bubble enlarged, filled the cavity, and the liquid disappeared; on cooling the crystal was evidently fissured and the liquid had vanished. No evidence could be obtained of the presence of carbonic anhydride.

Mr. CROOKES suggested the examination of the enclosed gas in a vacuum by the induction spark and spectroscope after fracturing the crystal by heat.

"*Examination of Substances by the Time Method*," by J. B. HANNAY. The author has determined with great care the loss of weight sustained by various hydrates in equal and successive intervals of time when submitted in a Liebig's drying tube to a current of air forced over them at various temperatures. He finds by this method that a hydrate usually begins to lose water more or less rapidly up to a certain point, when the rate of loss becomes suddenly less rapid up to another point, when the rate of loss is again decreased, and so on. These alterations in the rate of loss indicate the formation of other and lower hydrates, which lose water less rapidly, and so evidence of the existence of hitherto unknown hydrates has been obtained. Thus magnesium sulphate at 100° C. lost in five minutes, 8·36 per cent = $MgSO_46H_2O$; the loss is then pretty regular until about 29 to 30 per cent have been lost in forty-five minutes, leaving $MgSO_43H_2O$ when the rate falls; the weight then diminishes slowly till $MgSO_42H_2O$ is left, when the loss becomes suddenly very slow until $MgSO_2H_2O$ remains. Sodium sulphate, zinc sulphate (which presents some anomalies), ferrous sulphate, calcium and strontium chlorides were examined. Numerous tables and graphic curves illustrate this paper.

"*On the Dehydration of Hydrates by the Time Method*," by W. RAMSAY, Ph.D. Part I.—*Iron and Aluminium Hydrates*. The method employed was similar to that used by Mr. Hannay. The substances first examined were the hydrates of aluminium and iron. The author considers that hydrates such as $Al_2O_34H_2O$, $Al_2O_33H_2O$,

&c. (excepting $Fe_2O_3H_2O$), have no existence, or that a very large number of hydrates exist, the vapour tensions of which are very slightly different from each other: the hydrates of copper and lead were also examined, and evidence obtained of the existence of $3PbOH_2O$ and $2PbOH_2O$.

Mr. GROVES said that the author seemed only to have determined the loss at one pressure, viz., that of the atmosphere. It would be interesting to know what would happen if the pressure as well as the temperature was varied.

Professor CHURCH suggested the name of baro-hydrates for substances whose water of hydration varies with pressure, and hydrohydrates for those which vary with the moisture of the atmosphere.

Dr. ARMSTRONG considered Mr. Hannay's method valuable, and likely to give important information, but thought, on the whole, it would be preferable to determine the vapour tension directly.

Mr. CROOKES called attention to the fact that small quantities of hygroscopic moisture would not come off from glass surfaces for weeks in a vacuum at the ordinary temperature, but required the aid of heat.

"*On the Transformation of Aurin into Rosaniline*," by R. S. DALE, B.A., and C. SCHORLEMMER, F.R.S. By the action of ammonia on aurin peonin or red aurin is formed; by heating peonin to 150° C. for several days with alcoholic ammonia the red colour disappears, and a yellow liquid is obtained; on adding water a white crystaline precipitate is deposited, which presents all the characteristic properties of rosaniline. It is soluble in acetic acid, with a splendid crimson colour, &c. The reaction by which the rosaniline is formed is—

$$C_{20}H_{14}O_3 + 3NH_3 = C_{20}H_{19}N_3 + 3H_2O.$$

According to Hofmann the formula of rosaniline is—

$$C_{20}H_{19}N_3;$$

on this point the authors promise a careful investigation of the base and its salts. The authors believe aurin and rosolic acid to be identical. Pure aurin is prepared without difficulty by heating a mixture of sulphuric acid and pure phenol on a water-bath, and adding oxalic acid gradually, leaving always an excess of phenol.

"*On certain Bismuth Compounds*," Part VI., by M. M. P. MUIR. After an historical sketch of the attempts made to prepare hypobismuthous oxide, the author describes its preparation by Schneider's method, viz., dissolving stannous chloride and bismuthous oxide in hydrochloric acid, pouring the solution into strong potash and washing the black precipitate with weak potash. By heating to 180° C. hypobismuthous oxide, Bi_2O_2, is oxidised; it readily parts with its oxygen to reducing agents. By subliming bismuthous chloride, or by the action of nitrogen trioxide on fused bismuthous chloride, an oxychloride ($Bi_3Cl_3O_2$, or $Bi_4Cl_3O_3$) is produced; by a similar reaction an oxychloride, $Bi_8Br_6O_{15}$, can be formed. Bromide of bismuth is more readily oxidised than the chloride. The author compares phosphorous with bismuthous chloride. By the action of sulphur on bismuthous chloride sulphbismuthyl chloride, BiSCl, is prepared; $BiSCl_3$ could not be obtained. The author also failed to prepare a bromochloride containing 5 atoms of bromine+chlorine. By acting on metallic bismuth a bismuthous oxide suspended in strong potash with bromine, bismuthic hydrate is very readily produced.

"*On the Theory of the Luminous and Non-Luminous Flame*," by J. PHILIPPSON. In this paper the author merely states what he considers to be the causes of the luminosity and non-luminosity of flames.

After the thanks of the Society had been returned to the authors of the above papers, it was announced that the present volume of the Royal Society's *Proceedings* was nearly completed, and that any Fellow of the Society wishing to have the next volume was requested to send his subscription (10s.) forthwith to Mr. Hall, or to Messrs. Taylor and Francis. The Society then adjourned till June 7th, when the following papers will be read:—"On the Gases Enclosed in Lignite," by J. W. Thomas; "On Narcotine, Cotarnine, and Hydrocotarnine," by Dr. Wright; "On Otto of Limes," by C. H. Piesse and Dr. Wright.

A General Meeting will be held on Thursday, May 31st, at 8 p.m.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

May 14th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

C. O. CECH describes experiments on the "*Action of Amines on Chloral*," in which either ethylamin, aniline, or toluidine acted on chloral cyanide-cyanate, or the hydrochlorates of these amines acted on chloral hydrate and potassium cyanide. Both methods yield the same results—crystalline bodies, not admitting of a further substitution of amides, and possessing the general formula—

$$NH\begin{cases} C_2H_5 \\ HC_2Cl_2O. \end{cases}$$

A. PINNER has obtained similar bodies by the action of acetate of aniline, &c., on the acetyl compound of chloral cyanide, but regards them, however, as identical with the amides of dichloracetic acid.

The following communications have been received from non-resident members:—

LADY SIEMENS, "*Benzyl-Acetic Acid and Dibenzyl-Acetic Acid*." These two acids, $C_7H_7.CH_2.COOH$ and $(C_7H_7)_2CHCOOH$, are obtained by the action of benzylchloride on natrium-aceto-acetic ether, and subsequent saponification. The latter acid is changed by alkalies into dibenzyl methane.

A. WEBER, "*Derivatives of Dimethyl-Aniline*." These consist of mono-nitro, di-nitro, mono-bromo, and mon-iodo substituted derivatives, prepared by the usual methods. None of these bodies undergo, by treatment with caustic soda, a decomposition analogous to that of nitroso-dimethyl-aniline, which yields by this reaction nitroso-phenol and dimethylamin.

F. WITTING and J. POST have obtained two "*Isomeric Sulpho-xylens*" by the action of fuming sulphuric acid on xylen. They were changed successively into the chloride and amide, separated from each other by fractional crystallisation in the latter form, and then the acids were regenerated by treatment with HCl in sealed tubes.

H. KOMMRATH, in a "*Contribution to the Theory of Chemical Affinity*," gives various mathematical formulæ for determining the number of possible isomers in compound substances.

F. v. GORUP-BESANEZ has established the presence of small quantities of "*Glutamic Acid in the Germs of Vetches*."

A. C. CHRISTOMANOS, "*Specific Gravity of Iodine Trichloride: a New Method of Determining the Specific Gravity of Bodies which are easily Decomposed*." As ICl_3 can only be preserved in an atmosphere of Cl or CO_2, and cannot be weighed, its specific weight was determined by weighing a specially prepared flask filled successively with Cl and CO_2, and then repeating these operations after the addition of a sufficient amount of ICl_3. The specific gravity thus obtained is 3·1107. The method can be applied to a number of similarly loosely-composed bodies.

E. NOLTING and F. B. BOASSON separate "*Monomethyl-Aniline*" from the reaction-products of aniline and methyl-iodide, or aniline hydrochlorate and methyl-alcohol, by treatment with sodium nitrite. Aniline is changed into diazobenzene-chloride, dimethyl-aniline into nitroso-dimethyl-aniline, and mono-methyl-aniline into methyl-phenyl-nitrosamine, which is extracted with ether, and then changed back by reducing agents quantitatively to monomethyl-aniline.

F. Krafft, "*Oxy-chloro-Derivatives of Benzene.*" The so-called trichloro-phenomalic acid obtained by Carius from benzene, by the action of potassium chlorate and sulphuric acid, is found to be identical with trichloro-hydroquinon, $C_6Cl_3H_3O_2$. The reaction affords an interesting example of the possibility of a direct phenol formation from aromatic hydrocarbons.

"*On Perchloro-mesol.*" The author obtains, by the long-continued action of Cl on hexyl-iodide, $C_6H_{13}I$, besides perchloro-methane, perchloro-ethane, and perchloro-benzene, a colourless, crystalline body, C_4Cl_6, which he terms perchloro-mesol. Experiments on a series of fatty bodies show its formation to be as extensive as that of C_2Cl_6 or C_6Cl_6 by exhaustive treatment with Cl.

H. Kohler and A. Michaelis, "*Phenyl-phosphine and Phospho-benzene.*" Phenyl-phosphine was obtained in large quantities by the decomposition of phosphenylous acid:—

$$3C_6H_5PO_2H_2 = 2C_6H_5PO_3H_2 + C_6H_5PH_2.$$

It unites easily with 2 atoms of oxygen, but with only 1 atom of sulphur. Phosphenyl-chloride and phenyl-phosphine yield, even in the cold, diphosphenyl,—

$$C_6H_5P.PC_6H_5,$$

analogous in structure to azo-benzene, but entirely different in properties. Phosphenyl-chloride and dimethyl-phenyl-phosphine yield methyl-phosphenyl-chloride,—

$$C_6H_5P.Cl.CH_3.$$

"*On Iso-phosphenyl-Sulphide.*" This body results from the action of H_2S on phosphenyl-chloride, and requires apparently a doubling of the simple formula C_6H_5PS.

"*On Phosphenyl-Ether.*" This ether, $C_6H_5P(OC_2H_5)_2$, a colourless, mobile liquid, of most revolting odour, is produced by the action of phosphenyl-chloride on sodium ethylate. By the action of water it forms the acid ether $C_6H_5P(OH)(OC_2H_5)$.

C. Böttinger has obtained, by the "*Action of Aniline on Pyroracemic Acid,*" a white crystalline acid of the composition—

$$C_9H_9O_2N.C_3H_4O_3 + C_6H_5NH_2 = C_9H_9NO_2 + H_2O.$$

A. Claus and D. v. Wasowicz have prepared, by the action of KCy on chloro-crotonic ether, "*Crotoconic Acid,*" $C_3H_4(COOH)_2$, distinguished by characteristic reactions and derivatives from its isomers, itaconic, citraconic and mesaconic acids.

A. Claus and G. Neuhöffer find, in experiments "*On Sulph-hydantoin,*" that it yields no derivatives with halogens or halogen compounds, and that, with alcoholic ammonia, amido-acetamide and ammonium sulphocyanide are formed.

C. Neubauer, "*Indirect Quantitative Estimation of Mixtures of Dextrose and Levulose.*" After estimating the total amount of sugar present in a solution, the relative amounts of dextrose and levulose can be ascertained by application of the fact that the ratio between the percentage of dextrose present and the difference between the actual angle of rotation and that reckoned on the assumption that the sugar consists entirely of levulose, is equal to the ratio between the constant of rotation of dextrose and the difference between it and the constant of levulose. The specific rotation of levulose for yellow light is found to be -100, instead of -106 as hitherto given.

A. P. N. Franchimont confirms the experiments of Thenard "*On the Freezing-point of Ether,*" showing that it lays below any degree of cold as yet attainable. Impure ether formed flocculent masses below $-31°$, but did not become crystalline.

R. Nietzki, "*Para-diamido-toluen and Toluquinon.*" By the reduction of ortho-amido-azo-toluen the author obtains a fourth toluylen-diamine, $C_7H_6(NH_2)_2$, in which the amido groups have the para position. The body is of interest as yielding by oxidation the hitherto-unknown toluquinon, $C_7H_6O_2$, which by reducing agents is changed to hydro-tolu-quinon, $C_7H_8O_2$.

J. Berendes, "*The Volatile Acids of Croton Oil.*" Tiglic acid is found to be identical with the methyl-crotonic acid of Frankland and Duppa. Formic, acetic, and isobutyric acids were isolated from croton oil.

E. Schmidt detects the "*Adulteration of Bees'-wax with Resin*" by treatment with HNO_3 and addition of ammonia. Pure wax yields a yellow solution; adulterated wax a reddish brown solution, caused by the formation of nitro-compounds.

The same has investigated crystals of brucin, and finds that they belong to the monoclinic system.

E. Bandrowski has obtained "*Acetylen-dicarbonic Acid,*" $C_4H_2O_4$, by the action of alcoholic potash on dibromo-succinic acid or isodibromo-succinic acid. It crystallises in needles, decomposes at 100°, and forms crystalline salts which are also easily decomposed.

E. Salkowski finds that the "*Formation of Phenol in the Animal System*" is due to the same causes which lead to the formation of indol.

L. Claisen, "*Organic Acid Cyanides.*" More extended details are given of the acid, $C_8H_6O_3$, obtained from C_6H_5COCN (Chem. News, xxxv., 142), and it is shown to be entirely different from that prepared by Hübner and Buchka under different conditions. Various reactions show it to be a true keton acid, and it receives the name phenyl-glyoxylic acid.

H. Schröder, "*Volume Relations of Solid Organic Compounds.*" A number of experimental results are deduced to show that CH_2 represents a difference of 15·8 in the specific volume of organic bodies. CO_2 is equivalent to 15·2, and C, H, and O occupy in general equal volumes. The organic salts of silver all yield specific volumes which are multiples of 5·14, the specific volume of Ag.

O. Jacobsen, "*Formation of Aromatic Hydrocarbons by Dry Distillation.*" As benzene is formed by the condensation of acetylen, so its higher homologues are supposed to result from the condensation of acetylen and allylen. This hypothesis enables the author to explain why dry distillation yields only such homologues of benzene as contain methyl groups in the side links, and why triply substituted benzenes are the highest compounds occurring in tar. He has detected in tar orthoxylen, the presence of which should be expected according to his theory.

"*On Phoron-cumen.*" This body, C_9H_{12}, is shown to be identical with pseudo-cumen.

"*Abnormal Solubility of Zinc Xylidate.*" The decrease in solubility with the rise of temperature is more remarkable than in any other known salt, and a solubility curve has been prepared. 100 grms. of water dissolve, at 0°, 36 grms. of the salt; at 100°, but 0·735 grm.; and at 135, but 0·5 grm.

J. Habermann has obtained "*Monomethyl- and Dimethyl-Resorcin*" by the action of caustic potash and potassium-methyl-sulphate on resorcin at a high temperature. They are colourless, oily liquids, with strong refractive properties and pleasant odours.

The same has obtained "*Glycyrrhizine,*" prepared from the root of *Glycyrrhiza glabra*, in a crystalline condition, and investigated its properties.

M. Hönig and M. Rosenfeld, "*Sodium Glucosate.*" The addition of sodium ethylate to an alcoholic solution of glucose yields a voluminous white precipitate of $C_6H_{11}NaO_6$, which is extremely hygroscopic, and decomposes in moist air. Treatment with Br gave the double compound, glucose-sodium bromide—

$$C_{12}H_{21}C_{12}NaBr.$$

O. N. Witt, "*Action of Amides on Amido-azo Bodies.*" The author's observations lead to the establishment of a law that the reaction between amido-azo bodies and the hydrochlorates of aromatic amines always causes the formation of colouring matters, belonging to two quite different classes. The indulines are formed by the condensation of the two molecules accompanied by the separation of NH_4Cl. The saffranines result from a condensation accompanied by the separation of two molecules of hydrogen.

NOTICES OF BOOKS.

The History, Products, and Processes of the Alkali Trade, including the most Recent Improvements. By CHARLES THOMAS KINGZETT. London: Longmans, Green, and Co.

THE author of the work before us has undertaken to give "a concise but comprehensive account" of what he very justly pronounces the largest branch of chemical industry in this country. Indeed, if we call to mind that the finished products of the alkali trade are themselves the raw materials for other branches of chemical industry, such as the manufactures of glass and soap, and that sulphuric acid, which is for the chemist what iron is for the engineer, is chiefly made at alkali works, and that its production has been improved and cheapened mainly with a view to the requirements of this trade, we shall admit that Mr. Kingzett has by no means over estimated the importance of his subject.

In the preface and in the introductory chapter the author makes some very judicious remarks on the bearing of industrial progress upon national wealth, inadequacy of the protection afforded by the patent laws, and the insufficient pay of chemists, and the lingering, longing fondness for rule-of-thumb work which still prevails even in quarters where we might hope for better things. He takes to task with not unmerited severity a recent writer who has spoken of laboratory work as a "kind of out-at-elbows trade," and who has actually stated his conviction that "a manager can be too much of a chemist." We do not, of course, deny the abtract possibility of this latter assertion, but we submit it is proved by daily experience that a manager can be, and often is, too little of a chemist. To offer chemists a pay less than that of an unskilled labourer is certainly the way to drive talent either into other channels, or to induce men of good chemical attainments to seek out some country where they may be more appreciated. The recent progress of Germans in the chemical arts becomes readily intelligible when we read the author's quotations from a speech recently delivered by Dr. Lunge before the Tyne Chemical Society. It was stated that one of the largest chemical works in Germany employed six chemists at from £300 to £400 per annum, and, in addition, retains the services of a chemist of reputation exclusively for theoretical work in the laboratory at a salary of nearly £2000 per annum. By such wise liberality the intellect of the nation is attracted into channels the most beneficial to the country. We prefer to drive our best men to speech-making!

After giving a brief account of the sulphur deposits of Sicily, of the attempts made to utilise the sulphur present in gypsum, of the gradual introduction of pyrites as the raw material in the manufacture of sulphuric acid, of Martin's artificial pyrites, and of Hill's process for utilising the spent oxide of iron used in purifying coal-gas, the author goes on to describe the soda-nitre of South America, now the great commercial source of the oxides of nitrogen. It is greatly to be regretted that these invaluable nitre beds lie in the territory of a nation which fetters the trade with an export duty.

Giving next an account of the early stages of the sulphuric acid manufacture, Mr. Kingzett enters upon the description of the plant and arrangements in actual use. The pyrites kilns are described and figured with the arrangement of the nitre pots, the dimensions and temperature of the chambers, and the amount and pressure of steam to be injected. Dr. Sprengel's process for the substitution of pulverised water for a great part of the steam receives a favourable notice. The Gay-Lussac and the Glover towers are next described and the latter are figured from designs supplied by the inventor. A variety of methods proposed at different times for making sulphuric acid without the costly lead chambers, are next briefly mentioned. None of these are at present in operation, but, as the author aptly observes, a knowledge of old processes and suggestions is by no means unimportant. The past history of discovery warrants the supposition that some one or other of these may, by an apparently slight modification or addition, suddenly rise to practical value.

After noticing the treatment of burnt pyrites, the extraction of copper, silver and gold, and the manufacture of sulphate of copper, the author gives a survey of the salt trade. It appears that in 1874, 459,756 tons of common salt were used in the alkali manufacture alone in the Lancashire and Tyne districts. On the statistics of the trade, however, the accounts given on pp. 75 and 80 respectively do not exactly agree. The structure and arrangement of the salt-cake furnaces, with the improvements patented by Cammack and Walker, and by Mactear, are described. Concerning the results of these inventions it would be premature to give a decided opinion. After a sketch of the condensation processes devised by Kuhlmann and by the late Mr. Gossage—the latter of which has proved a decided success, enabling the alkali-maker to go beyond the letter of the law, and condense not 95 but 99 per cent of the hydrochloric acid gas generated—we come to the important improvement of Mr. Hargreaves. This invention aims at suppressing the chambers and salt-cake furnaces together and at making sulphate of soda by the direct action of sulphurous acid, air, and steam upon the salt. There is reason to hope that this process will be found commercially successful. It evidently carries the matter a step further than any of the suggestions for an improved process for making sulphuric acid mentioned on p. 52, and again adverted to, somewhat needlessly, on p. 91. A sample of salt-cake made by Mr. Hargreaves on the large scale showed, on analysis, 99·24 per cent. of actual dry sulphate of soda.

The black-ash furnace and its product are next described. The author quotes the elaborate analyses of black-ash, or ball soda, given by Mr. G. E. Davis, in his paper read before the Society for the Promotion of Scientific Industry, May 25th, 1875. He expresses the hope, in which we heartily join, that Mr. Davis may soon find time to elaborate and publish his new methods of analysis.

Passing over much interesting matter which want of space forbids us to notice, we come to the manufacture of caustic soda. Time was—and that within the memory of many who would scarcely call themselves old—when caustic soda was not an article of commerce. No one, save a licensed soap-boiler, could legally make it, and he was forbidden to sell, or even, we believe, to give it away. All other manufacturers who had occasion for caustic alkali in any of their operations were always in dread lest some "active and intelligent" excise officer might become aware of their proceedings and bring upon them the heavy penalty for that case provided. So much mystery prevailed concerning the very nature of caustic alkalies, that within the last half century a receipt for making a liquor for scouring wool by the very simple process of heating together solution of carbonate of soda and caustic lime, actually found a purchaser at the price of £300. To look back to those days from our present condition seems like a dream. In 1867 the production of caustic soda in the Tyne district alone reached 3720 tons, whilst in Lancashire, in the previous year, it amounted to 11,213 tons. Since then the manufacture has been developed to such a degree that "many works now turn out from 100 to 250 tons weekly.

The *bête noir* of the alkali trade is the residual product known as alkali-waste, tank-waste, or vat-waste, but which, by a singular confusion of language, is in some quarters called "black-ash." To the composition of this substance, as given by our author on the authority of Muspratt and Dawson, we must invite particular attention—

	Fresh.	Six weeks old.
Carbonate of lime	41·20	23·42
Silicate of magnesia	3·63	1·78
Phosphate of alumina and iron ..	8·91	7·40
Sulphate of lime..	2·53	4·59
Hydrate of lime	8·72	12·03
Calcium disulphide	5·97	0·62
Calcium sulphide	25·79	36 70
Sodium sulphide..	1·44	2.87
Water	1·73	10·59
	99·92	100·00

It will be particularly noticed that no salts of potassa are here present, and that the phosphates here given, those of lime and alumina, are insoluble in water. It stands to reason, indeed, that this substance being the residue of a process of careful and prolonged lixiviation should be practically free from matter soluble in water. Yet a recent patentee has actually has spoken of it as containing "90" (probably per cent.) of soluble matter. In the alkali districts the nature of this refuse is but too well known. As our author has remarked, "for years it has accumulated, and has evolved poisonous gases into the air, and given off offensive drainings which have polluted many streams." It has actually been proposed for use as a manure, but as its composition would at once suggest to any chemist, the result was something worse than a mere failure. It has been used for making floors, and for filling up clay-pits, &c., but, on every change of weather its emanations were most offensive. The most effectual method of dealing with this refuse is to use it for the manufacture of hyposulphite of soda, and the recovery of the sulphur by the processes of Guckelberger, Mond, and Mactear. The latter process is said to be now in actual operation at St. Rollox, Glasgow, where 30 tons of sulphur are recovered weekly, and more could be reduced if required. What the recovered sulphur costs we do not find stated.

Mr. Kingzett has shown that at high temperatures salt is converted by sulphuretted hydrogen into sodium sulphide, hydrochloric acid being evolved. The decomposition, indeed, is incomplete, and in the experiments performed has not exceeded 15 per cent. Still the author thinks that this question deserves a further investigation. The attempts which have been made to supersede the ordinary process of alkali making altogether next receive consideration, especially the so-called "ammonia process," as worked out by Solway and Honigmann. Concerning these processes it is difficult to obtain accurate information. Concerning Honigmann's process, we are told that it "is in work at Vagy and Bocsko, but late advices from Germany are to the effect that the process does not pay so well as was anticipated." Some of the latest improvements of Gerstenhofer and Honigmann are kept secret. As for Solway's process there appears also to be a doubt in how far the anticipations of its success are being fulfilled, and here also certain improvements are said to be kept secret. It is unfortunately becoming more and more customary to protect a process in general by a patent, but to work certain details in secret. We do not approve of this device, which will put formidable weapons in the hands of those who seek to abolish patent-right altogether. We think that an inventor should be either a patentee or a secret-worker, but not in one and the same matter a mixture of both.

We regret that we cannot notice those portions of the work devoted to Mr. G. E. Davis's method of making soda, phosphoric acid, and salts of alumina, from a mixture of phosphate of alumina, sand, salt-cake and slack, the formation of alkali-waste being altogether dispensed with. Nor can we enter upon an examination of the improved methods of generating chlorine invented by Mr. Deacon and Mr. Weldon, both of which are described at some length. The remarks on coal-smoke towards the end of the work seem to us vitiated by a fundamental error. A very great part of the evil resulting from smok is surely due to the enormous quantity of sulphurous acid evolved from the pyrites present more or less in all coal. This escape of acid fumes no improved stoking, no better arrangements for the admission of oxygen into the burning fuel can diminish. What we can do, and what we ought to do, lies here. Having found the minimum of coal with which any given kind of work can be practically carried on, we must, by legislative measures, drive all manufacturers down to that standard.

The value of Mr. Kingzett's work is great. Not merely does it supply a mass of valuable information not easily procurable; it shows the student what improvements have been already effected, what difficulties remain, and what attempts have been made for their removal. It thus puts any chemist who has the opportunity of taking up such subjects in a position of advantage by showing him at once what to investigate with the fairest prospect of success. In so doing it places the profession under a profound obligation.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris, No. 5, March 5, 1877.

Reactions Produced by Aqueous Trimethylamin in Metallic Solutions.—M. C. Vincent.—The aqueous solution of trimethylamin is a valuable reagent which may be easily procured. Trimethylamin is obtained by calcining in closed vessels the residue left on the distillation of beet-root treacle. Its separation from the ammonia simultaneously produced is easy and complete. Trimethylamin behaves with metallic solutions in a manner different from ammonia. With a neutral solution of magnesian salts it gives a white precipitate of hydrate of magnesia, insoluble in excess. If the liquid is acid enough to form a sufficient quantity of a salt of trimethylamin this precipitate is not produced. The addition of a solution of phosphate of soda gives then rise to a white amorphous precipitate, which by degrees becomes crystalline. With salts of glucinum there is formed a white precipitate insoluble in excess, as also with zirconium. With salts of alumina there is formed a white precipitate soluble in excess. With proto-salts of cerium there falls a white precipitate, and with ceroso-ceric salts a whitish rose precipitate, both insoluble in excess. With ferrous-salts there is formed a dirty white precipitate, and with ferric salts a bran, both insoluble in excess. With the green variety of sesqui-salts of chrome there is produced a grey precipitate, and with the violet variety a greenish blue precipitate, both insoluble in excess. With proto-salts of manganese there is formed a white precipitate which quickly becomes coloured on exposure to the air. If the solution is acid, or if a salt of trimethylamin is added, even in large excess, a precipitate insoluble in excess is still formed. With cobalt there is formed a blue-grey precipitate insoluble in an excess of the reagent. With nickel the precipitate is apple-green insoluble in excess. Sesqui-salts of uranium: a yellow precipitate insoluble in excess. Zinc and cadmium: white precipitates insoluble in excess. Stannous and stannic-salts: white precipitates, the former insoluble, and the latter soluble in excess. Antimony: salts of Sb_2O_3 a white precipitate insoluble in excess; Sb_2O_5 a white precipitate soluble in a large excess. Bismuth: a white precipitate insoluble in excess. Lead: the neutral acetate of lead is not precipitated by trimethylamin, but the other salts of lead give white precipitates insoluble in excess. Copper: a light blue precipitate insoluble in excess. Mercury: Hg_2O a black precipitate insoluble in

an excess; HgO and HgCl a yellow precipitate which is insoluble in excess, but turns a lighter yellow. Silver: a deep grey precipitate soluble in large excess. Chloride of silver is perfectly insoluble in trimethylamin. Palladium: a brown precipitate soluble in excess. Gold: the perchloride of gold gives a light yellow precipitate soluble in excess. Platinum: bichloride of platinum gives a yellow precipitate of the double chloride soluble in a large excess of water, much more soluble in hot water, and crystallising on cooling.

Normal Presence of Copper in the Blood of Wild Herbivorous Animals.—M. S. Clocz.—We must admit as a fact the constant presence of copper in the blood of animals living at large in the midst of forests, remote from industrial establishments where cupreous preparations are dealt with. It is not decided whether it is introduced in food or in water, nor whether it is peculiar to the plasma or to the blood globules.

Action of Alkaline Sulphocyanides upon the Hydrochlorates of the Bases of the Fatty Series.—M. P. de Clermont.

Rapid Extraction of Caffein.—MM. P. Cazeneuve and O. Caillot.—The authors pour upon 1 part of tea, 4 parts of boiling water, and when the leaves are softened add 1 part of recently slaked lime. They evaporate to dryness in the water-bath, place the residue in their displacement apparatus, and exhaust with chloroform. The solution in chloroform is then distilled to dryness. The residue is taken up with boiling water, filtered through a moistened filter, and the solution evaporated on the water-bath, when white caffein is obtained in fine crystals.

Volumetric Determination of Chrome.—MM. F. Jean and H. Pellet.

Volumetric Analysis of a Mixture of Alkaline-Earthy Sulphates.—MM. F. Jean and H. Pellet.

Volumetric Determination of Oxalic Acid and of Oxalates.—F. Jean and H. Pellet.—These three papers will be inserted in full.

Atomic Weight of Selenium.—MM. Petterson and G. Ehman.—The weight found is 79·08.

Atomicity of the Metals of the Rare Earths.—M. L. F. Nilson.

Certain Chloroplatinates.—M. L. F. Nilson.

Chloroplatinites.—M. L. F. Nilson.—These papers are not suitable for abstraction.

Amount of Ammonia in Solutions of Different Densities.—M. Wachsmuth.—The author gives his results in the form of tables.

Biedermann's Central-Blatt für Agrikultur Chemie,
Heft 3, March, 1877.

Geographical Distribution of Hail.—Prof. H. Fritz.—The maximum precipitation of hail is between 40° and 60° lat. It decreases as we pass from the west of Europe towards the east.

On Schübler's "Water-retaining Power."—Prof. Adolf Mayer.—The full or maximum "water-capacity" of a soil may be considered as the sum of the capillary spaces of the soil expressed in the weight of the masses of water by which they are filled. The water-capacity increases practically with the minute division of the soil, with the equality in the size of its particles, and with the porosity of the solid matter. This water-capacity, however, throws little light upon the great differences which exist between natural soils as regards their power of storing up water.

Investigations on the Cultivation of the Sugar Beet.—A. Pagnoul.—Not adapted for abstraction.

Absorption of Plant-Food by a Meadow, from Liquid Manure.—A. Leplay.—The liquid manure in question consisted of the household slops and evacuations from three dwellings, the liquid excrements from stalls holding sixty head of cattle, and the bodies of dead animals. The author finds that as the liquid flows along over a grassy surface its percentage of plant-food decreases at first rapidly. As it becomes poorer the residual impurities are retained more obstinately.

Investigations on the Growth of Leaves.—Dr. F. G. Stebler.

Researches on the Influence of Light and Radiant Heat on the Transpiration of Plants.—Prof. J. Wiesner.

Two valuable contributions to vegetable physiology.

Absorption of Silicic Acid by Plants.—F. B. Wilson.—The author maintains that free silicic acid, in a state of very fine division, is capable of assimilation by plants, but that the simple compound silicates, whether natural or artificial, are useless in manures.

Influence of Copperas and Carbolic Acid added to Manures upon the Germination of Seeds and the Growth of Plants.—Prof. J. Nessler.—The sulphates of iron and carbolic acid, when present in minute quantity and equally distributed, had no injurious action. If not evenly diffused damage was occasioned in certain places.

Researches on the Consumption and Deposition of Reserve-Matter in the Tubers of the Potato.—Dr. J. Fittbogen. The harvest of tubers should be undertaken on the complete decay of the plant. If commenced earlier, loss is experienced both in quantity and quality.

Influence of Leaves upon the Ripening of Grapes.—Prof. J. Nessler.—It appears that the removal of leaves diminishes the formation of sugar.

Laws of the Nutrition of Forest Trees.—G. Wagener.—Not suitable for abstraction.

Influence of Certain Salts and of Lime upon the Optical Determination of Sugar.—A. Muntz.—Taken from the *Comptes Rendus.*

Distribution of the Nitrogen of Barley among the Products of Brewing.—F. Zmeylikar.—Of 100 parts of combined nitrogen present in barley, only 12·87 remain in the beer; the rest may be considered as wasted.

A New Theory of the Formation of Butter.—Dr. Fr. Soxhlet.—Butter is present in milk not in solid globules, but as a liquid, in minute drops.

Percentage of Sulphuric Acid in Wine as a Sign of its Sophistication.—Prof. J. Nessler.—We quote, with regret and astonishment, the following passage:—"In Southern France, Spain, Greece, and other southern countries, the grapes are sprinkled over with gypsum. The grape-juice can and must here, therefore, take up a large quantity of sulphuric acid. *This cannot be considered as an adulteration, since in many places it has been practised immemorially and universally.*" Hence, in Prof. Nessler's opinion, fraud is to be tolerated if only old and common enough!

Justus Liebig's Annalen der Chemie,
Band 185, Heft 2 and 3. February 19, 1877.

Researches from the Chemical Laboratory of Kasan.—Communicated by Alex. Saytzeff.—These consist of a paper on the "Synthesis of Diallyl-carbinol," by Michael Saytzeff; "Action of a Mixture of Iodallyl with Iodethyl and Zinc upon Formiate of Ethyl," by J. Kanonnikoff and Alex. Saytzeff; "Synthesis of Allyl-dimethyl-carbinol," by Michael and Alex. Saytzeff; "Synthesis of Diallyl-methyl-carbinol," by B. Sorokin; "Remarks on the Formation and Properties of the Non-saturated Alcohols described in the Preceding Memoirs," by Alex. Saytzeff; "Synthesis of Diallyl-oxalic Acid," by Michael Saytzeff; and "Preparation of Iodallyl and Anhydrous Acetic Acid," by J. Kanonnikoff and M. Saytzeff.

Certain New Pieces of Apparatus for Use in the Chemical Laboratory.—F. Frerichs.—These consist of

a new filtering apparatus, capable of being modified either for quantitative analysis or for the preparation of compounds; an apparatus for determining vapour densities, and an arrangement for taking specific gravities. None of these instruments can be intelligibly described without the accompanying illustrations.

Communications from the Laboratory for Applied Chemistry at the University of Erlangen.—A. Hilger.—These communications comprise the following papers:—1. "Analyses of Minerals and Rocks," by A. Hilger. The author gives analyses of zinkenite,—double sulphide of lead and antimony; of fahlore, from the "Clara" mine in the Schappbach Valley, where it occurs along with clarite; of trachyte, from Wolferlingen in the Westerwalde; of nickeliferous magnetic pyrites, from Todtmoos, in the Black Forest; and of Upper Franconian Eklogite. 2. "The Brown-coal of Bauersberg, near Bischofsheim vor der Rhön," by A. Hilger. 3. "On Cyclamin, Primulin, and Primula-Camphor," by Dr. L. Mutschler. The author finds that cyclamin is a crystallisable glucoside, which, on boiling with dilute acids is resolved into glucose and cyclamiretin. It is identical with primulin, the glucoside found in the roots of the primrose, and is probably common to the whole family of Primulaceæ. It is also probably identical with saponin. Primula camphor is also a constituent of the primrose root, and has the empirical formula $C_{22}H_{24}O_{10}$. It yields salicylic acid on treatment with potassic hydrate.

Communications from the Laboratory of the University of Halle.—These communications consist of a memoir by E. Schmidt and Rud. Köppen, on the "Preparation, Properties, and Compounds of Veratrin."

Evolution of Oxygen from Green Twigs exposed to Solar Light in Water previously Boiled.—J. Böhm.—If green twigs of woody plants are enclosed, in the absence of light, in a limited oxygenated atmosphere, there occurs at first a decrease, but afterwards, and before the entire consumption of the oxygen present, an increase of the volume of the gases. The decrease of the volume of air which ensues when green twigs are enclosed in an oxygenated atmosphere in darkness, or in a faint light, is not dependent on the assimilation of oxygen,—as in the germination of oleaginous seeds,—but on absorption of the carbonic acid formed during normal respiration. If recent portions of plants are placed in pure carbonic acid, and in a tube closed with mercury, there ensues at first a decrease, but subsequently, in consequence of internal respiration, an increase of the volume of gas. The absorption of carbonic acid by recent parts of plants does not depend exclusively on the cellular juice, for it takes place also—just as in charcoal—in sprays previously dried at 100° C. If fresh green shoots of privet are exposed to sunshine under water which has been previously boiled, much more oxygen is evolved than what corresponds to the volume of air present before the experiment. It is chiefly derived from carbonic acid split off from the substance of the twigs in consequence of internal respiration.

On Certain Halogen Derivatives of Isomeric Nitrotoluols.—Dr. Carl Wachendorff.—A long memoir, not capable of useful abstraction.

Apparently Anomalous Decompositions by Carbonic Acid.—Fr. Mohr.—Among these cases the author enumerates the decomposition of acetate of baryta by carbonic acid, the cause of which he finds in the insolubility and cohesion of the carbonate of baryta. Acetates of lime and strontia are not precipitated by carbonic acid. After citing other instances of the decomposition of acetates, phosphates, &c., he remarks—"Sulphur-pyrites are not attacked by hydrochloric acid, but in Nature it is converted by carbonic acid and oxygen into hydro-ferrite. Rock crystal dissolves neither in fluoric acid nor in caustic alkali, but in Nature we find corroded quartz crystals interpenetrated with aqueous chlorite. We find pseudomorphoses of the most insoluble bodies, such as fluor-spar and heavy spar, where these substances must have been dissolved away in water. We know no solvent for peroxide of manganese, and yet we find pyrolusite in beautifully formed crystals. Here time effects what the strongest affinities are unable to accomplish."

A Contribution to the Knowledge of the Cinchona Barks.—O. Hesse.—A detailed account of cusconin and aricin, with their salts.

On Conchinin.—O. Hesse.—An examination whether Henry and Delondre were the discoverers of conchinin, and whether it may be appropriately named chinidin (quinidin).

Milky Juice of the Seed-Capsules of Papaver Rhœas.—O. Hesse.—This juice after inspissation contained no morphia, but 2·1 per cent of rhœadin and traces of other partially crystalline alkaloids.

Communications from the Laboratory of the University of Erlangen.—Gorup Besanez.—These contributions consist of a memoir "On Selenium Compounds," by Dr. L. v. Pieverling; a paper on "Certain Derivatives of Rhenish Beech-wood Tar," by W. Bräuninger; and a memoir on "Heptylic Acid from Œnanthic Oil and some of its Derivatives," by Th. Mehlis.

MEETINGS FOR THE WEEK.

MONDAY, May 28th.—Royal Geographical, 8.30. (Anniversary).
TUESDAY, 29th.—Royal Institution, 3. "Davy's Chemical Philosophy," Prof. Dewar.
—— Civil Engineers, 8.
WEDNESDAY, 30th.—Society of Arts, 8.
THURSDAY, 31st.—Royal Institution, 3. "Heat," Prof. Tyndall.
—— Royal, 8.30.
FRIDAY, June 1st.—Royal Institution, 9. "History of Education," Mr. Oscar Browning.
—— Geologist's Association, 8.
SATURDAY, 2nd.—Royal Institution, 3. "Discoveries at Mycenæ," Mr. C. T. Newton.

TO CORRESPONDENTS.

J. W. Chessman.—The work on Leather Dyeing is not published in England. It is written in English, and has been printed by Grunert Bros., 16, Junker Strasse, Berlin, for the Actien Gesellschaft für Anilin Fabrikation, Treptower Brücke, Berlin. It was got up by the Company for distribution at the late Philadelphia Exhibition, and does not appear to be on sale.

Delta.—Liebig's, Johnson's, or Church's works on Agricultural Chemistry in English, and Ville's in French, are about the best. The first two are, we fear, out of print.

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THE CHEMICAL NEWS.

Vol. XXXV. No. 914.

ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 213.)

132. The repulsion being due to the action of radiation on the surface of bodies, it became of interest to ascertain whether doubling the amount of incident radiation would produce double the movement. In my earlier apparatus I could not detect any such action as would show that it followed the law of inverse squares (109). There were, however, many reasons why this might not have come out with the apparatus then used; the glass torsion-thread might have been too stiff, or the source of light too near; the pith surfaces were white instead of black, and the vacuum was by no means so good as I have subsequently been able to obtain. The experiment described in par. 129, where the angle formed by the arm carrying the black and white disks was found to vary as the light approached or receded, appeared to me likely to afford valuable information on this point; and I accordingly fitted up more delicate apparatus on the same principle.

133. I wished to suspend the arm carrying the blackened pith in such a manner that it should move to the very slightest force, and still return accurately to zero when the force ceased to act on it. The principle of Professor Zöllner's horizontal pendulum* seemed well adapted for this; and I accordingly fitted up an apparatus shown in the annexed figure.

A tube (*a b*) about an inch in diameter has two narrower tubes (*c d*) blown on to it near one end, so that they shall be at right angles to the large tube, but not quite in the same straight line, the upper tube (*c*) being about a quarter of an inch nearer the end *a* of the wide tube. In the wide tube is a straw beam, carrying at the *a* end a disk of lampblacked pith, and at the other end a silvered glass mirror. At *e* is a plug of glass, firmly fixed in the tube *c*, and carrying a very fine glass thread. In the tube *d* is another similar thread of glass, having at the end a weight made of glass tube and mercury. The two threads are firmly fastened to the straw beam, behind the mirror, in such a manner that the upper thread in *c* holds the beam a quarter of an inch nearer the pith end than the lower thread in *d* holds it, as shown in the enlarged view. By adjusting the tension on the glass fibres, the beam can be kept in a horizontal position along the axis of the tube *a b*. The whole is supported on a stand furnished with finely cut levelling-screws, and, according to the principle of the horizontal pendulum, the sensitiveness of the beam to any force applied at the pith end can be increased or diminished at pleasure by tilting the end *a* of the apparatus up or down; this can be easily effected by turning the milled head of the screw *f*. A ray of light from a lamp is reflected from the mirror to a graduated scale, and appropriate screens are used to cut off from the pith disk all radiation, except that being experimented on. The apparatus is connected to the pump by means of the glass spiral shown at the upper part of the tube *c*. On lowering

Fig. 2.

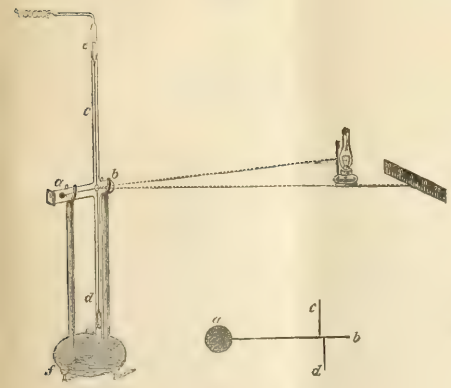
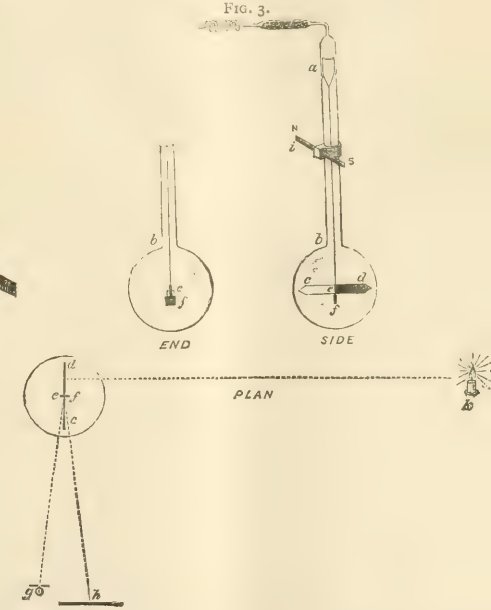


Fig. 3.



* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

† *Pogg. Ann.*, 1873, vol. cl., pp. 131, 134.

the end *a* of the horizontal tube, by means of the screw *f*, the oscillation of the beam becomes very rapid, and its sensitiveness diminishes. On raising the end *a* the time of oscillation can be increased to any desired amount, with corresponding increase in sensitiveness. The other levelling-screws are for the purpose of bringing the beam into the centre of the horizontal tube. If the tube is too much tilted up, the centre of gravity gets too high, and the pith falls to one side or the other of the tube. The most convenient degree of sensitiveness I found to be that accompanying an oscillation at the rate of one per minute.

The ray of light used as an index of movement was reflected to a graduated scale 4 feet off. The instrument, mounted and adjusted as above described and highly exhausted, was found to be very sensitive. A ray of light from a candle 10 feet off, falling on the pith, would cause the index ray to move through 15 divisions; when 5 feet off the index moved about 60 divisions, and when 20 feet off the index moved between 3 and 4 divisions. These movements were sufficient to show that the motion of the pith was in inverse proportion to the square of the distance the candle was from it.

I tried numerous experiments with this apparatus, and verified the law perfectly; but there were difficulties connected with working with it which induced me to devise another instrument, free from the objections attending the use of the horizontal pendulum, and at the same time simpler to make and equally sensitive to faint radiation.

134. The objections to the use of the horizontal pendulum were the following:—When sufficiently sensitive to indicate readily the action of faint light, I found it almost impossible to bring the index to zero; the oscillations were so slow, and, taking place in a vacuum, kept on for so many minutes that my patience became exhausted with waiting for the next observation. But if I ventured to move away, or, when standing close to the apparatus, even to shift the weight of the body from one leg to the other, that was sufficient to alter the level of the floor, and therefore of the horizontal beam; the spot of light would suddenly fly ten or twelve degrees in another direction, and all the tedious waiting had to be gone over again, and possibly another zero had to be taken. A person running up stairs, a child playing in the adjoing room, a passing carriage, or a railway-train, all had their influence on the level of the laboratory floor. I tried fixing the apparatus to a main wall of the house, but this did little good. When the instrument was brought to its highest pitch of sensitiveness, to watch the movements of the index ray when it should have pointed to zero gave one the impression that my house rested on an india-rubber cushion, so sensitively did it shift its level in obedience to a passing vehicle; and yet it is very well built, and the part where my work is mostly done was erected by myself some years ago, and was made of extra strength for the purpose of physical research. An incredibly small angular movement of the base of the instrument is, however, sufficient to cause the luminous index to move. In a paper by Professor O. N. Rood,* "On the Application of the Horizontal Pendulum to the Measurement of Minute Changes in the Dimensions of Solid Bodies," the author illustrates his method of determining the change of volume of bodies. The levelling-screw of his instrument, corresponding to screw *f* in my apparatus (fig. 2), rests on the body the change in whose dimensions is the subject of study (such as a bar of iron about to undergo magnetisation). Professor Rood gives experiments which show that an increase of thickness under the screw equal to the $\frac{1}{3000000}$ of an inch is an appreciable quantity!

135. The following apparatus (fig. 3) is much simpler than the horizontal pendulum, and is free from the objections noted above; whilst its available sensitiveness is almost as great, and has the advantage of being capable of being increased or diminished within very wide limits.

A glass tube (*a b*), 16 inches long and 1 inch diameter, has a 4-inch bulb blown on to the lower end. *c d* is a bar of pith $\frac{3}{4}$ inch wide, $3\frac{1}{2}$ inches long, and $\frac{1}{16}$ inch thick. One-half (*d*) is coated with lampblack, and the other half left white, as shown in the figure. The pith bar is suspended in the bulb by a very fine cocoon fibre. Through the centre of the pith bar, at *e*, and at right angles to it, is passed a magnet (101) about $\frac{1}{2}$ inch long, made out of a fine steel sewing-needle. To the ends of this magnet are attached cocoon fibres, which support a small square of silvered glass (*f*), hanging freely below the pith bar and at right angles to it; a reference to the *end* view will show the arrangement. At the upper part of the tube (*a b*) are seen the tube filled with cocoanut-shell charcoal, and the spiral glass tube for connection with the mercury-pump. The arrangement for an experiment is shown in fig. 3, *plan*. A ray of light (*g f h*) from a slit in front of a lamp falls on the mirror (*f*), and is thence reflected on to the scale (*h*). The apparatus is so placed that the index ray falls near zero when the magnet (*e*) has assumed its normal north-south position. It may be brought accurately to zero, and the sensitiveness increased or diminished at will, even during an experiment, by means of a control-magnet on a cork sliding up and down the tube, as shown at *i*, either close to the bulb or at some distance off, and acting with or contrary to the earth's magnetism, according to the sensitiveness required.

The instrument was exhausted and re-exhausted, with repeated heatings of the charcoal-tube, in the manner already described (131). It was finally sealed off from the pump, the charcoal still remaining attached to it, and it was set aside for some months. The following experiments were tried with it after it had arrived at its maximum sensitiveness.

(To be continued.)

* Read before the National Academy of Sciences, November 4, 1874, and published in *Silliman's Journal* for June, 1875.

ON THE

ELECTRO-MOTIVE ORDER OF CERTAIN METALS IN CYANIDE OF POTASSIUM, WITH REFERENCE TO THE USE OF THIS SALT IN MILLING GOLD.*

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

WHILE on an official visit at the Thames Goldfield I had many opportunities for observing the marked effect of cyanide of potassium in preventing the flouring of mercury used in working off the blanketings. These blanketings I found have, as a rule, a decidedly acid reaction, due in a greater part to the presence of ferric and ferrous salts soluble in water, and it is to the former of these salts that what is commonly known as "flouring," is mainly due in the process cited above; such ferric salts being able to either oxidise or chlorodise the surface of any mercury they may be in contact with, thus enfilming it with a compound which, being practically insoluble in water, or in water charged solely with the salts occurring in mineral workings, prevents that metallic contact taking place between detached mercurial globules which is necessary to amalgamation.

In remedying or preventing flouring so occasioned, this salt (cyanide of potassium) acts by decomposing these mercurial compounds and dissolving in part or wholly their constituent portions, while the surface of the mercury not thus floured it keeps metallic, by preventing ferric salts acting in the manner stated; these salts being decomposed by this cyanide as they would by any other salt, having, as it has, an alkaline reaction.†

* Read before the Wellington Philosophical Society, January 29th, 1876.

† I will reiterate here, the opinion of mine already published, that before putting in the cyanide to the blanketings, they should be made alkaline by the addition of common soda; less cyanide would then be requisite, and thus working expenses be reduced.

In effecting these useful results, it is thus seen that cyanide of potassium dissolves a portion of the mercury used; besides this there may be another portion of mercury, though a much smaller one, dissolved away from the metal itself by the direct action of the cyanide upon it, aided by the free oxygen always present; this happens if no metal is dissolved in the mercury used, or is in contact with it, having a greater affinity for cyanogen than mercury has. Moreover, in thus contemplating the contingencies entailed or risked by the use of any alkaline cyanide in such milling operations, it must be remembered that both gold and silver are not absolutely insoluble in these cyanides. Now, the loss of mercury in this way may not be serious, but if *gold* or even *silver* be thus lost (that is, by its solution), even in much less quantity than mercury well could be, the loss then may be serious.

Now, whether the loss of metal certain to be entailed by the use of cyanide of potassium falls upon the mercury, or upon the gold or silver of these blanketings, conjointly or separately, depends entirely upon the relative affinity of these metals for this salt, or, in other words, it depends upon their electro-motive order therein. According to our present knowledge in regard to this subject, mercury is positive both to gold and silver; under these circumstances the loss of metal would therefore fall upon the mercury, which is, of course, desirable; thus we have it distinctly affirmed that neither "gold, silver, or platinum, directly precipitate mercury from its solutions." But feeling the importance of this subject, and, moreover having, for various reasons, grave doubts as to the correctness of these opinions, I investigated this matter for myself, and soon found that in reality mercury is not positive to either gold or silver in cyanide of potassium, as supposed, but very decidedly negative; thus metallic gold in contact with a solution of mercuric cyanide would rapidly dissolve and mercury be reduced. A knowledge of this fact prompted me to determine the electro-motive order in cyanide of potassium of the various metals which occur in our gold fields, or are employed in any way for milling gold. In the following list most of these will be found; it runs from negative downwards to positive:—

Electro-motive Order of Metals in Potassic Cyanide.

Carbon.	Lead.
Platinum.	Gold.
Iron.	Silver.
Arsenic.	Tin.
Antimony.	Copper.
Mercury.	Zinc.

Most, if not all the sulphides or other ores occurring in nature. are negative to the whole series. Any of these metals will generally precipitate the ones named below it from its cyanide solution. As already stated, gold and silver thus precipitate mercury, taking its place in the liquid,* while, as is already known, silver precipitates gold. In relation to this, however, I find these two metals (gold and silver) are so nearly alike in their affinities for cyanogen, that this precipitation is a very slow process; cyanide of potassium even in contact with an alloy of silver and gold dissolves both, the silver, however, to the greater extent.

Thus, it appears, a loss of gold by solution of it must frequently happen whenever cyanide of potassium is employed to assist in the amalgamation of blanketings, or other auriferous stuff. In fact, all that loss of metal occasioned by its solution, and most of which is, as we have seen, a necessity involved in the working of the process itself, falls upon the gold and silver present, the mercury being positively protected from the action of this salt by these more valuable metals.

* The precipitation of mercury upon gold from a solution of mercuric cyanide, is a very delicate and easy test for gold *in stone*, even when in the form of specks so minute as to be only visible by the aid of a microscope; the yellow colour persistent at a red heat of the speck to be tested, and the instantaneous whitening of it occasioned by this cyanide, may be taken conjointly as proving that it is gold.

Further, as the rapidity of action of any exciting solution upon the positive element of a voltaic pair is (other things being equal) the greater the more electro-negative to this solution the negative element is, it will happen that the solution, and consequent loss of gold and silver in such operations will be the greater when they are carried on in *berdans*, as the iron of which their receiving part is made, as also the ball, is very negative to gold under the circumstances stated. The loss of gold in this way will be also greater the more free cyanide of potassium there is present, proportional to the stuff; when the quantity is small the loss is perhaps not serious. Whatever it is, however, I think it may be avoided, at least, in a greater part by allowing the waste liquor from the blanketings to run in a thin stream over copper plates.

ON SALICYLOL (SALICYLIC ALDEHYD).

By Dr. T. L. PHIPSON.

An attempt was made recently in my Laboratory to obtain the essence of *Spiræa ulmaria* by oxidising a mixture of phenol and grape sugar, with the aid of bichromate of potash and sulphuric acid. The results were somewhat curious, though not entirely satisfactory. Much depends upon the proportions used, the temperature, &c. A large amount of resinous substances were produced; but on following up the action of the bichromate (used in the same proportions as with salicine) by permanganate of potash, a moment arrives when the odour of phenol ceases, and a strong unmistakable odour of the plant arises. This occurs at 50° C.; but the addition of more permanganate causes it to vanish. A minute quantity of salicylol was, however, obtained by distillation. If the oxidation is pushed further there is developed a strong smell of urine, and sometimes an odour of caoutchouc oil. The liquid, before distillation, allows a brownish precipitate to deposit in a few days. This, collected on a filter, and boiled with potash solution, is dissolved, and developes at the same time, in a very marked manner, the characteristic odour of benzoïle. Acids precipitate the potash solution: the precipitate is light brown, gelatinous, insoluble in boiling water, but soluble in alcohol.

In preparing nitro-salicylic acid by heating to boiling, artificial salicylic acid with diluted fuming nitric acid, the liquid became dark reddish brown, and developed at the same time a strong odour of salicylol: after the nitro-salicylic acid had crystallised, the mother-liquid yielded a notable quantity of salicylol to ether. In heating salicylic acid mixed with water (much less than will dissolve it), with nitrite of potash, a still larger quantity of salicylol is produced, at the same time the nitro-salicylic acid formed combines with the potash. By adding a little sulphuric acid to the liquid, whilst still warm, the nitro-salicylic acid separates in fine needles on cooling.

Chemical Laboratory, Putney,
London, S.W.

Presence of Bacteria, &c., upon the Walls of the Wards of Hospitals.—A square metre of the wall of one of the surgical wards in the Hospital la Pitié was washed—an operation which had not been performed for two years previously—and the liquid wrung out of the sponge was immediately examined. It contained micrococci in abundance (50 or 60 to every field of the microscope), some micro-bacteria, a small number of epithelial cellules, some pus globules, red globules, irregular blackish masses, and ovoid bodies of unknown nature. Every precaution was taken to avoid causes of error; the sponge used was new, and had been quite recently thoroughly washed in distilled water.—*Les Mondes.*

ON THE

METALS WHICH ACCOMPANY IRON.

By M. A. TERREIL.

THE numerous analyses that I have made during several years of the principal ores of iron, and of their metallurgic products, have convinced me that iron, like platinum, is almost always accompanied in its ores by several metals which are found in the metallurgic products of this metal, and which I shall call the *metals of iron ores*. These metals, besides manganese, which has always been mentioned, are principally magnetic metals of the family of iron, such as *nickel*, *cobalt*, and *chrome*, the presence of which was considered as characteristic of meteoric irons. They are found, according to my observations, in almost all iron ores. These metals ordinarily escape analytical research by reason of their small proportion relatively to the mass of iron, and also because the ammoniacal salts, which are produced in the analytical operations, completely mask the properties of these metals. Besides these metals of iron ores, irons, cast-irons, and steels contain also several accidental metals, which are *copper*, *vanadium*, *titanium*, and *tungsten*.

To detect these metals which accompany iron in the mine I have adopted an analytical method, which I shall describe. After having treated the substance in the ordinary way, either by *aqua regia* or by muriatic acid and chlorate of potash, I filter to separate the part insoluble in the acids, and after having washed the latter with great care in distilled water, I pour gradually, whilst stirring, the filtrate into ammonia. I avoid, as is seen, to pour the ammonia into the acid liquid: this precaution is very important, for in this last case the oxides soluble in ammonia remain fixed to the oxide of iron which is precipitated. I throw the precipitate obtained on a filter, and wash with distilled water. At this point of the analysis the metals of the ores of iron are divided into three groups:—(1) The metals which are found in the residue insoluble in acids, *titanium* and *tungsten*; (2) the metals precipitated along with the oxide of iron, *chrome* and *vanadium*: (3) the metals in solution in the ammoniacal liquor, *copper*, *nickel*, *cobalt*, and *manganese*.

I establish the presence of metals in the first group by treating, first, the insoluble residue upon the filter by ammonia, which dissolves the tungstic acid. The ammoniacal liquor, evaporated to dryness and slightly calcined, leaves the tungstic acid in the form of a greenish yellow powder, easy to characterise by the blowpipe. I dry afterwards the insoluble residue, and then treat with concentrated and boiling sulphuric acid, which dissolves titanic acid. I let cool, dilute with water, filter, and treat a portion of the liquid with zinc. The presence of the titanium is then indicated by the violet colouration which the liquid takes on adding zinc. In this case the other portion of the liquor is evaporated so as to drive off all the sulphuric acid, and I obtain thus a white residue of titanic acid, equally easy to recognise with the blowpipe. In all these cases this evaporation to dryness is necessary, even when zinc does not produce a violet colouration of the liquid; this colouration being no longer appreciable when there is too little titanic acid in solution.

To detect the presence of metals of the second group, *chrome* and *vanadium*, which were precipitated with oxide of iron, I employ the following method, which consists in suspending the precipitate of oxide of iron in a solution of pure potassa heated up to 90°. We then add permanganate of potash as long as the latter is decolourised. The permanganate transforms chrome and vanadium into chromate and vanadate of potassa. After this transformation, which is complete when the solution takes a green colour, we filter, saturate the alkaline liquor with acetic acid, filter a second time, when there is a production of oxide of manganese derived from the excess of permanganate employed, then into a portion of the liquor we pour a few drops of acetate of lead. There is produced a yellow precipitate of chromate of lead, which may be mixed with vanadate of lead. Vanadium is detected in the other portion of the liquor by adding a solution of tannin recently prepared. The vanadic acid slowly forms then with tannin a blue-black or greenish black precipitate, although the liquid is immediately coloured. When the yellow precipitate of chromate of lead contains vanadate of lead it is likewise coloured a black-blue or a greenish black, when it is moistened with the solution of tannin.

I recognise the metals of the last group in the following manner:—I add to the ammoniacal liquor which contains them a few pieces of pure potassa. I raise to a boil to drive off the ammonia and to decompose the ammoniacal salts, and I heat until the ammoniacal odour has completely disappeared. The potash precipitates the metals in the state of oxides. I collect these oxides on a filter, wash, and take a small portion, which I treat on a plate of silver with melted potassa and nitre. To recognise manganese, finally, I dissolve the rest of the oxides in hydrochloric acid. I separate copper by sulphuretted hydrogen, and after the filtration of sulphide of copper I heat the filtrate to drive of the excess of sulphuretted hydrogen, and to concentrate this solution as much as possible. I finally treat with ammonia. The blue-violet tint which the liquor takes indicates sufficiently the presence of nickel. As for the cobalt, I detect it in the following manner:—I pour into the ammoniacal liquor a few drops of permanganate of potash, which peroxides the cobalt, and which precipitates the manganese. I heat some minutes, so that the precipitation of manganese may be complete, filter, supersaturate with muriatic acid, and after adding a little alcohol wait twenty-four hours. I then find at the bottom of the liquor a violet-rose precipitate of roseo-cobaltic hydrochlorate (discovered by M. Fremy) quite characteristic. The liquor treated with potash gives a precipitate of oxide of nickel of an apple-green colour.

As to the proportions of metals which accompany iron they are ordinarily very slight in the metallurgic products which I have had occasion to treat, they rarely attain a total of five-thousandths, whilst in the native or meteoric irons these proportions reach 10 per cent. These differences are sufficient to serve to distinguish meteoric irons from common irons, but I must recall that M. Daubrée on melting peridote obtained a cast-iron, in which I found 1·6 per cent of chrome and 1·16 per cent of nickel; an important fact, for it may throw some doubt on the extra-terrestrial origin of certain irons supposed to be meteoric. —*Bulletin de la Soc. Chimique de Paris.*

ON THE

PREPARATION AND THE USE IN CASTING STEEL OF ALLOYS OF SILICON AND MANGANESE.

By SERGIUS KERN, St. Petersburg.

IN a recent communication of M. Gautier to the Iron and Steel Institute, on "Solid Steel Castings," the author called attention to some metallurgic experiments made during the last few years in France, at the Terre Noire Works, in order to obtain solid steel castings,—that is to say, ingots of steel without the well-known peculiar blowholes, which are due, as Mr. Bessemer showed, to the presence of carbonic oxide (CO), which, while the steel is in a melted state, is dissolved in it, and when the liquid metal commences to solidify an excess of carbonic oxide escapes, as liquid steel dissolves more of this gas than the solidifying mass. This remaining gas, which had not time to escape, gives rise to these blowholes, which much injure the uniformity of castings. Mr. Bessemer used, a long time since, silicon-iron in order to prevent the formation of blowholes. Silicon acts chemically on the carbonic oxide by the following reaction:—

$$2CO + Si = SiO_2 + 2C.$$

Thus the formation of blowholes is prevented, and in the mass of the ingot carbon and silica are deposited in a finely-divided state. Mechanical experiments proved that the resulting ingots give steel with a very high degree of tension.

It must be mentioned that the free carbon which is deposited in the metal when the silicon alloy is added to the metallic bath of the furnace acts very energetically on the oxides of iron, which cannot be entirely reduced by the addition of ferro-manganese. The carbon acts on the oxides of iron as follows, yielding carbonic oxide, which is, secondly, destroyed by the addition of a rich alloy of silicon :—

$$Fe_2O_3 + 3C = 3CO + Fe_2 ; \text{ or}$$
$$2FeO + 2C = 2CO + Fe_2.$$

My experiments show that it is preferable to use an alloy of silicon, manganese, and iron, in order to reduce in the same time the iron-oxides of the metallic bath by the manganese of the alloy, and to prevent the formation of blowholes in the ingots by means of the silicon of the alloy. By using an alloy of such kind we kill two birds with one stone.

I prefer the use of alloys with 70 to 75 per cent of manganese, 18 to 16 per cent of iron, 10 to 6·50 per cent of silicon, 2 to 2·50 per cent of carbon, and foreign matter. In melting steel in Siemens-Martin furnaces, at the end of the operation about 1 to 1½ per cent by weight of this alloy is added to the metallic bath. The results of the use of such an alloy are highly favourable : the cast-steel obtained gave the following results on being mechanically tested :—

	Tons per square inch.	
	Began to Stretch.	Breaking Weight.
Sample No. 1	24·8	48·5
,, No. 2	27·2	48·8
,, No. 3	26·7	49·2

The same alloy is recommended by M. Gautier for the purpose of obtaining solid steel castings; at Terre Noire it is prepared in blast-furnaces. But as not every steel foundry has furnaces of such kind, it is desirable to obtain this alloy in a foundry having at its disposition only the ordinary coke crucible-furnaces.

The following process may be used for the production of silicium alloys with ferro-manganese. The alloys contain 6 to 10 per cent of silicon; an alloy containing 6 per cent of silicon and 60 to 70 per cent of manganese is quite suitable for metallurgic purposes. The raw mass consists of—

	Pounds.
Ferro-manganese (60 to 70 per cent of manganese, 6 to 7 per cent of carbon)	220
Iron in small strips	25
Quartz of good quality	100
Calcium fluoride ($CaFl_2$)	155
	500

All these substances, in a form of powder, are mixed with the iron in strips and coal-tar in such a quantity as to obtain a pasty mass, which is well dried and divided in four parts, and is placed into four crucibles. The thickness of the crucibles should be from 1¼ to 1⅜ of an inch. The crucibles, with well-fitted covers, are placed in coke-furnaces for about five hours. The resulting alloy contains 6·650 per cent of silicon, a quantity ordinarily quite sufficient. The alloy generally contains 1 to 1·50 per cent of carbon, nearly all the carbon of the ferro-manganese being reduced in the form of graphite, which is found in the middle of the ingot. This graphite, by breaking the ingot, may be easily separated. By using ferro-manganese with a higher percentage of carbon, and increasing the quantity of quartz and calcium fluoride in the above-mentioned mixture, alloys with 7 to 12 per cent of silicon may be obtained.

The following is the explanation of the use of calcium fluoride proposed by me for the preparation of silicon-manganese alloys :—Calcium fluoride with quartz firstly gives the following products :—

$$12CaFl_2 + 4SiO_2 = 4CaSiFl_6 + 8CaO.$$

The calcium silico-fluoride next very easily gives silicon to the melting ferro-manganese alloy; the resulting calcium oxide forms, with the remaining quantity of quartz and a certain quantity of manganese, a liquid slag, preventing well the liquid metal from further oxidation.

This process gives silicon-manganese alloys with less expense than by melting ferro-manganese with quartz alone.

Obouchoff Steel Works.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 215.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

From the production of sulphuric acid at different heights in the chamber, which for an equal cubic space was approximately equal, Hasenclever inferred that within certain limits a chamber was the better the fewer square metres of sheet lead it required for a metre of cubic contents.

The lead chamber which Hasenclever has lately constructed for the Rhenania Chemical Works, near Stolberg, is 10 metres high, 10 broad, and 40 long, and requires, therefore, 0·45 square metre of sheet lead for a cubic metre of volume. In almost all earlier chambers the consumption of lead was greater.†

Calculation of the Yield of Acid.—As to the amount of real acid present in the aqueous sulphuric acid, several tables, more or less mutually discordant, are used in chemical works. In the recent manuals of Graham-Otto, Wagner, Bolley (Schwarzenberg), and others, the statements of Bineau have been adopted as the most accurate. But in many manufactories calculations are still based on the earlier statements of Vanquelin, d'Arcet, Dalton, and Ure. In drawing up the latter tables it is assumed that the sulphuric acid of commerce at 66° B. is not a pure hydrate, but contains, at sp. gr. 1·830, 6 to 7 per cent of water more than H_2SO_4. Latterly Kolb‡ has published detailed and accurate investigations on the proportion of monohydrate in acids of different specific gravities, which in a great measure confirm the statements of Bineau. The discrepancy which has hitherto prevailed in this respect depends not on the unequal proportions shown by different tables, but on the unequal graduation of the Beaumé hydrometers. Gerlach‖ has given an interesting conspectus of the specific gravities answering to the single degrees of the scale of the hydrometer.

As in sulphuric acid works Beaumé's scale is chiefly

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† In connection with the author's communications on the process in the chambers we mention the recent proposal of Sprengel (English patent No. 3189, A.D. 1876) to supply the chamber with pulverised water instead of with steam. The water in the interior of the chamber is converted into a mist by forcing air or steam into a stream of water. The apparatus by which this comminution of the water is effected is founded on the same principle as the "*pulvérisateur*" used in medicine, or the "*rafraichisseur*" of the perfumers, known in England as the "atomiser." The advantage of the introduction of pulverised water is chiefly an economy in fuel. According to reports which have reached the Editor this water dust has been already advantageously introduced in several establishments. In works which employ the Glover tower this improvement is of little value.—A. W. H.

‡ J. Kolb, *Bull. Industr. de Mulhouse*, Feb. 28, 1872.

‖ Gerlach, *Dingl. Pol. Journ.*, cxcviii., 313.

employed* a concordant graduation of this hydrometer is much to be desired. Kolb in his tables has introduced a new graduation, since adopted by many, where 0° B. = the sp. gr. of water at 15° C., and 66° B. = the sp. gr. of monohydrated sulphuric acid at 15° C. (= 1·842). The relation between Beaumé and specific gravity is consequently expressed by the equation—

$$d = \frac{144\cdot3}{144\cdot3 - n},$$

d expressing the sp. gr. and n the degree of Beaumé.†

It would be highly desirable if all manufacturers of sulphuric acid would base their calculations on the same tables, for in statements on the yield of sulphuric acid at 66° B. from pyrites or sulphur different tables are often used, so that the results of different works are not directly comparable.

The following conspectus of the statements of different tables may be of interest in this respect.‡

Degree of Beaume.	Sp. Gr. according to Kolb.	Proportion of Monohydrate according to— Tables of Various Works. Vanquelin.	Arcet.				Bineau.	Kolb.
10	1·075	11·73	—	11·5	11·40	—	10·98	11·0	10·8
20	1·162	24·01	—	23·3	23·46	—	21·97	22·4	22·2
30	1·263	36·52	—	36·9	36·60	—	35·93	34·9	34·7
40	1·383	50·41	—	51·6	51·49	—	49·94	48·4	48·3
50	1·530	66·54	66·45	66·9	66·17	63·8	63·92	62·7	62·5
60	1·711	84·22	82·34	83·3	82·80	79·4	79·90	78·0	78·1
66	1·842	100·00	100·00	100·0	100·00	94·0	97·87	100·0	100·0

(To be continued.)

NEW GERMAN PATENT LAW.

The new German Imperial Patent Law has received the assent of the Reichstag, and comes into operation on July 1st, the separate patent arrangements of the German Kingdoms and States coming to an end.

The duration of a patent under the new law is fifteen years, and the direct payment to Government—exclusive of agency and other incidental expenses—amounts to £265. This very heavy tax, however, is made less burdensome by being spread out over the whole duration of the patent. The first charge is only £2 10s., for the second year an equal sum, and for the third £5. For every future year the tax increases progressively by £2 10s., the idea obviously being not to tax invention heavily until it has proved commercially successful. Few unremunerative patents, it is anticipated, will be retained beyond the first few years of their life. The patentee may pay any of these yearly taxes within three months of the date legally fixed. This is a concession of no small value, as we have known an English patent lost through mere inadvertence; and if an oversight of this nature occurs the only remedy is a private Bill in Parliament, which, if successful, is very costly.

There are certain limitations concerning the granting and the holding of patents, the policy and the justice of which may give rise to a variety of opinion. No patent will be granted for pharmaceutical compounds, medicines, alimentary preparations, and chemical products, though processes for obtaining such articles may be legally claimed. In some cases, we suspect, it will be here very difficult to draw the boundary line. An invention cannot be imported,—*i.e.*, a German citizen who has become acquainted in some foreign country with a manufacturing process, without being himself the inventor, cannot take out a patent for it in Germany. Anyone who can prove that he has previously used a process, or made a machine or article subsequently patented, cannot be restrained from continuing to use or make the same. But such "user," unless it has been made public, is no bar to the validity of the patent as against any third party. No foreigner can apply for a German patent in his own name, but must empower a German citizen to make application.

But inventors whose improvements are not excluded by any of the limitations above mentioned will not receive a patent as a matter of course. The patent commissioners, with the aid of experts chosen for the purpose, will examine every application. We cannot here refrain from adding that if the traditions of the late Prussian Patent-Office are followed by the new Imperial Commission, refusals will be far from rare.

From the ordinary Commission an appeal lies to a special Commissioner, and from him again to the Imperial Court at Leipzig. These steps, we submit, cannot be taken without extra expense to the applicant, who will doubtless require legal—and often also scientific—advice and assistance. Nor does the favourable report of the Commissioners, if obtained, render the right of the patentee absolute, since on the publication of the invention—which, as far as we can perceive, takes place after the award of the Commissioners—opposition may be entered. Many other powerful arguments against the system of preliminary examination have been already advanced in the Chemical News and elsewhere, and do not require recapitulation.

But even when a German patent is obtained its continuance for the full term of fifteen years, subject merely to the payment of the annual tax, is not a matter of course. The inventor's right is determinable—

a. If after three years the inventor has not carried out the manufacture or the process to a proper extent.

b. If he refuses licenses to others who offer a fair royalty.

The objections against the former of these clauses are perfectly overwhelming, and the second is scarcely more defensible. We could understand their adoption by a Government wishful in an indirect manner to crush invention. But the German Government is, we believe, sincerely anxious to promote alike scientific research and its application to practical affairs, and our regret at finding

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* This, of course, refers only to the Continent.—*Ed.* C. N.

† As Beaumé's hydrometer is still almost exclusively used in chemical manufactures, the above formula, especially for laboratory use, is of considerable interest, and a closer investigation of its origin may not be unremunerative. If a hydrometer sinks in water to 0°, and in another liquid D, of the sp. gr. d only to n the two unequal volumes of displaced liquid have each the same weight, *i.e.*, the weight of the hydrometer. If we call the weight of this hydrometer G—the weight of a volume of water corresponding to the volume of a degree of the scale being taken as unity—we have the weight of the volume of water displaced by the hydrometer = G; the weight of an equal volume of the liquid D of sp. gr. d = G d; the weight of the water displaced by n degrees of the scale = n; the weight of an equal volume of D = nd. This latter weight is the difference between the weights G d and G, and we have therefore—

$$G.d - G = nd;$$

whence—

$$d = \frac{G}{G - n} \text{ and } G = \frac{n.d}{d - 1}.$$

For the case of monohydrated sulphuric acid of sp. gr. 1·842 in which at 15° C. Beaumé's hydrometer sinks to 66° we substitute these values in the last formula for d and n, and for G we put the number 144·3, and we have then—

$$d = \frac{144\cdot3}{144\cdot3 - n}.$$

The number 144·3 represents the weight of the hydrometer if the weight of the volume of water corresponding to the volume of a degree of the scale is taken as unity.—A. W. H.

‡ Till very recently the sp. gr. of monohydrated sulphuric acid was given as 1·848. See, *e.g.*, "Handbook of Chemistry," by Leopold Gmelin, vol. ii., p. 184 (Cavendish Society's edition).

such provisions in the new Patent Law is even surpassed by our astonishment.

Inventors holding patents in any of the German States can have them converted into Imperial patents for the remainder of the time they have to run, and no delay should take place in making application.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

May 26th, 1877.

Professor G. C. Foster, F.R.S., President, in the Chair.

The following candidates were elected members of the Society:—Lieut.-Col. A. C. Campbell, of Blythswood; Dr. H. Debus, F.R.S.; W. T. Thiselton Dyer, M.A., B.Sc.; W. Jack, M.A.; and Capt. Sale, R.E.

Lieut.-Col. Campbell explained and exhibited a double slit which he has employed for measuring the distances between the lines in the spectrum, and finds of great service in cases where the illumination is so slight as to preclude the possibility of using the ordinary micrometer. One slit remaining stationary, the other can be moved at right angles to its direction by means of a very delicate micrometer screw of 200 threads to the inch, the graduated head of which is capable of distinctly indicating one five-millionth of an inch in the motion of the slit. If now a reading of the micrometer be taken when the slits are superposed and form one continuous slit, and a second reading when any given line has been superposed upon any other line at a moderate distance from it, the difference between these readings will enable us at once to ascertain the distance between the lines, if the micrometer be calibrated in terms of the spectrum as seen in the observing telescope. The author has made several measurements with this apparatus, and finds it to be capable of extreme accuracy, but it is, of course, essential that the movable slit remains within a moderate distance of the axis of the collimator.

He then described a simple arrangement for automatically fixing a prism, when placed on the table of a goniometer, at the angle of minimum deviation when different coloured rays are under examination. To the arms which support the telescopes of the goniometer are attached two short links, of equal lengths, connected at their extremities with a nut sliding freely on an arm which is fixed radially to the centre table of the instrument. The prism is held on this table with its base at right angles to this arm, and it thus remains adjusted for all the rays of the spectrum.

Mr. O. J. Lodge then read two papers by Professors Ayrton and Perry, jointly, of the Imperial College of Engineering, Japan. The first contains an account of an elaborate series of experiments on "*Ice as an Electrolyte*." The apparatus employed consisted of a flat copper box containing a disk of the same metal supported on three pieces of glass, and just covered by distilled water. The box is closed by a water-tight lid traversed by a thermometer and an insulated wire from the disk, and the whole is placed in a freezing mixture. They state, as a result of their experiments, that the capacity per c.c. of ice at $-13{\cdot}5^\circ$ C. is 0·002 micro-farad, and the specific inductive capacity is 22,160 (that of air being called unity), while that of water at $8{\cdot}7^\circ$ C. is about 2240 times this amount. Commencing with ice at $-13{\cdot}6^\circ$ C. the temperature was allowed to rise, and the conductivity determined by galvanometer readings. From these a very regular curve was deduced which shows that the conductivity increases regularly, and that there is no sudden rise in passing from the solid to the liquid state. The apparatus was also employed for determining the electromotive force of polarisation currents at different temperatures by replacing the copper by a zinc disk.

The second communication contained suggestions for experiments "*On the Viscosity of Water and other Liquids*." It is accompanied by working drawings of an apparatus which the authors have designed for determining the relation between the viscosity of a liquid and the velocity of a surface moving in contact with it. They have, however, no facilities for making such an apparatus, and therefore place it at the service of anyone who may be willing to study the subject.

NOTICES OF BOOKS.

On some Points in connection with Vegetation. By Dr J. H. Gilbert, F.R.S.

In this paper, the substance of an Address delivered in the Chemical Section of the Science Conferences at South Kensington, Dr. Gilbert discusses a very difficult and important question—the sources of the nitrogen of vegetation. A certain quantity is doubtless obtained from the combined nitrogen existing in the atmosphere: this may amount to about 8 to 10 lbs. yearly per acre. But the amount of combined nitrogen withdrawn by crops from a soil to which no nitrogenous manure has been added averages, over a period of 32 years, 20 lbs. per acre per annum. Hence there are only two possibilities: either the soil derives nitrogen from some additional source or the vegetation draws upon a stock of nitrogen in the soil derived from previous accumulations. M. Ville concludes from his experiments that certain large-leaved plants—such as colza, and in a less degree sunflower and tobacco—assimilate free nitrogen from the atmosphere. On the other hand, the researches of M. Boussingault and of the author "have not given an affirmative answer to the question whether plants by their leaves take up and assimilate the free nitrogen of the air."—The evidence, according to the two latter authorities, is strongly against the supposition that plants can avail themselves of the free nitrogen by the reaction between it and nascent or ozonised oxygen within the plant itself. Another supposition is that the free nitrogen of the atmosphere may unite, *outside the plant*, with the nascent oxygen evolved by the plant, and so yield nitric acid. On this hypothesis Dr. Gilbert remarks:—"It is at any rate certain that in our experiments we have not been able to persuade plants to avail themselves of this happy faculty of producing their own nitrogenous food."

Another supposition is that free nitrogen may be combined not by any action of the plant, but under the influence of the soil. This view was advocated thirty years ago by Mulder, and has been recently revived by Dehérain. Here, however, the evidence is still conflicting. Bretschneider found a gain of combined nitrogen in a mixture of humus and quartz-sand, exposed to the air for a year, but protected from rain and insects. Boussingault's experiments show in some cases a gain, but in others an actual loss. Berthelot has recently succeeded in forming a fixed nitrogenous body by exposing moistened cellulose to an electric current in an atmosphere of free nitrogen. He objects to the latest experiments of Boussingault as having been performed on soils in closed glass vessels, where the intervention of atmospheric electricity must be of necessity excluded.

Dr. Gilbert sums up by remarking that the answer to the question, What are the sources of the nitrogen of vegetation in general, and of agricultural production in particular? is more likely to be found in the relations of the atmosphere and of the plant to the soil than in those of the atmosphere to the plant itself." The author is very far, however, from considering that a definite conclusion has yet been reached, and earnestly invites chemists to enter more thoroughly into the subject.

A Primer of Chemistry, including Analysis. By ARTHUR VACHER. London: J. and A. Churchill.

THE author informs us that this little work "represents a ten years' experience in teaching the rudiments of chemistry and analysis." He introduces two new terms: instead of atoms and molecules he speaks of *units*, and instead of radicals—or radicles, as they have latterly been called—of *anti metals*. His arrangement of the elements is original; the list of metals given commences with silver, and ends with hydrogen. Arsenic and silicon rank among the non-metallic bodies. As the standard of value for metals he takes Ag; his reason for giving it precedence in the list, and the standard for anti-metals, is Cl, the one of these being exactly antagonistic to the other. The values of other anti-metals are shown by reference to chlorine, and those of other metals by comparison with silver. The whole number of elements mentioned amounts to thirty-five only. The substances commonly spoken of as acids are considered as salts of hydrogen. Thus, in the experimental instructions, sulphuric acid is designated as hydric sulphate. The analytical tables at the end have been printed privately some time ago, and have been for years employed in the author's laboratory. Several of them have also been published in his abridged edition of Fresenius's "Qualitative Analysis" (1869). It would certainly be very difficult to compress a larger amount of matter into 99 small pages. We regret to notice an orthographical, or rather kakographical, peculiarity. The author writes "odor," "color," "vapor," &c.—a practice which we hoped was confined to ticket-writers and promoters of "spelling-bees."

Short Poems, translated from the German. By C. A. CAMERON, M.D., F.R.C.S.I. Edinburgh and London: W. Blackwood and Sons.

BETWEEN poetry and chemistry the connection is not very close, and it is not without a certain amount of misgiving that we presume to pass any judgment upon the little volume before us. It consists of translations from various German poets, printed side by side with the original. Dr. Cameron gives the meaning of the original quite as accurately and closely as is consistent with the exigencies of rhyme and metre—which cannot by any means be said of all translations from the German. His verses, too, are easy and flowing. On what principle the poems have been selected it is not easy to see.

Contributions to the Knowledge of Deacon's Process for the Production of Chlorine. By Dr. KONRAD JURISCH, of Widnes. (Reprinted from *Dingler's Polytech. Journ.* for 1876, Bd. 221, p. 356.)

THE author remarks that when Deacon's process was taken up, within a short time, by more than twelve English and two German establishments, the view was generally entertained that the balls of clay steeped in solution of copper would ensure an uninterrupted production of chlorine gas for a year or two, if not longer. Before many months had elapsed complaints were heard of the action of the balls. He has therefore undertaken to determine what can be the cause of these balls declining so rapidly in their efficacy. His conclusion is that the true cause of this speedy decrease in the decomposition is due to sulphuric acid, which passes through the interstices of the clay-balls mixed with the other gases. This injurious action, according to Hasenclever and Sartori, is probably to be explained by the following reaction:—The vapour of sulphuric acid in contact with sulphate of alumina at a dull red-heat, as is found in the balls, is resolved into sulphurous acid, watery vapour, and oxygen: the sulphurous acid thus formed is re-oxidised at the expense of free chlorine, is again decomposed, and thus keeps up a destructive circulation in the apparatus which reduces, or totally checks, the production of chlorine.

Contributions from the Laboratory of the State University of Missouri. By Prof. P. SCHWEITZER. Jefferson City: Peter Hen & Carter.

THIS pamphlet contains researches on the true composition of coal, and on the methods of arriving at it; with deductions and remarks on coal in general. The author feels satisfied that—from a number of investigations similar to the one here presented, of Boone County coal—clearer views can be obtained regarding the origin, relative age, and manner of formation of coal, than from isolated phenomena or experiments of short duration. In this work he wishes to enlist other chemists. He finds the ash of the sample upon which he operated remarkable for the total absence of alkalies and of chlorine, for its small proportion of phosphoric acid, and relatively large amount of manganese. The insoluble residue—silica, alumina, some magnesia, and a little iron—existed, he thinks, "in the form of clay, and was precipitated from the muddy waters of the lagoon along with the vegetable matter which produced the coal." He considers that nearly the whole of the alumina, soluble or insoluble, of coal is derived from such a source, as this earth is in itself no constituent of the ash of recent plants, and as its very properties and constitution seem unfavourable to its passing through membranes or capillary apertures.

Another memoir is devoted to an account of the water-supply of Columbia, Boone County, Missouri.

In accordance with the author's point of view the mineral constituents have been mainly taken into account.

Report on some Chemical Analyses of the Waters from the Surface Wells and Pumps in the City of London. By W. SEDGWICK SAUNDERS, M.D., Medical Officer of Health and Public Analyst for the City of London. London: Skipper and East.

THIS Report shows the dangerous character of the public pumps in the City of London still remaining in use at the time when it was presented to the Commissioners of Sewers. These pumps all derived their supply of water from shallow wells, some 25 to 30 feet deep, and were, as the accompanying analyses show, fearfully contaminated. Nevertheless, as the water was clear and sparkling, attributes common in the most dangerous cases, these pumps were in high favour. Dr. Saunders may deservedly be congratulated on the suppression of this source of disease—a task in which he has had to encounter no small amount of prejudice.

A Series of Exercises in Experimental Physics. By C. J. WOODWARD and G. SMITH. Part I.—Acoustics, Light, and Heat (Elementary Stage). Part II.—Magnetism and Electricity (Elementary and Advanced Stages). London: Simpkin and Marshall. Birmingham: Cornish Brothers.

THE people of England are rapidly becoming divided into three classes—examiners, examinees, and those who are preparing their countrymen to undergo the fashionable operation. Much as we deprecate the examination mania, and convinced as we feel that the result must be hostile to original research, we must admit that these "Exercises" are, of their kind, good. The problems given are "such as should be answered by students preparing for the elementary stage of the Science and Art Department Examination, or the junior division of the Oxford and Cambridge Local." They are not specially adapted to any text-book, it being considered that any manual used for the above examinations will supply the preliminary information needed.

After going over a chapter in his text-book, the student is recommended to take the corresponding chapter in these exercises and work out the examples given. In case of subjects of unusual difficulty some preliminary remarks are added for the guidance of the student.

On a Form of Insanity which may be termed Toxiphobia. By C. A. CAMERON, M.D., Professor of Chemistry and Hygiene to the Royal College of Surgeons in Ireland, Medical Officer of Health and Public Analyst for Dublin.

It appears that there is a particular form of monomania in which persons, otherwise perfectly rational, imagine—without the slightest ground—that some one is attempting to poison them. Since the year 1860 Dr. Cameron has met with sixty-three such cases, excluding *bona fide* instances of poisoning. Some curious details are given in the pamphlet before us. Thus a petty sessions clerk "brought me a night-cap and night-shirt which he said were charged with some subtle poison, for when he put them on they made his 'skin creep,' and produced a pain like the stinging of nettles. He said that his persecutors came at night and blew into his room—through the key-hole, through the window if left open, and even down the chimney—a white powder, which, when inhaled, produced great irritation of the lungs, followed by weakness."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 18, April 30, 1877.

Carbuncular Disease.—MM. Pasteur and Joubert.—In this paper, which is rather pathological than chemical, the authors examine whether there is a disease caused by the development in the blood of animals of the small filiform bodies, or bacteridia discovered by M. Davaine.

Probable Consequences of the Mechanical Theory of Heat.—M. Favé.—The author seeks to show that the phenomena ascribed by M. Boutigny to a particular condition of matter—the so-called spheroidal state—are naturally explained if we admit that the thermic waves of the sidereal ether exert a repulsive action upon ponderable matter.

New Bed of Native Mercury Discovered by M. Quatrefages in the Upper Valley of the Hérault.—M. Leymerie.—In the Domaine du Cros, situated in a glen opening directly into the Valley of the Hérault, the decayed roots of a mulberry tree were being dug up. On breaking one of them there issued from it a wave of mercury. The country people are of opinion that the death of certain mulberry trees is due to the action of mercury. The soil is of a schistous nature.

Electro-Silicic Light.—M. G. Planté.—The author has previously remarked the brilliant luminous effects obtained on causing one of the poles of a powerful secondary battery to touch the sides of a glass or porcelain vessel containing a saline solution. The silicic origin of this light is proved by the fact that it is equally manifested on the contact of the electrode with pure silica in the state of crystals of hyaline quartz. A greater electric power is, however, required than for glass. The luminous effect results from the incandescence of silicium.

Compound Bodies capable of being Produced at a Temperature Much Higher than that at which they are Decomposed.—MM. Troost and Hautefeuille.—It is known that most bodies are decomposed under the influence of heat, and that such decomposition is complete if the temperature is raised sufficiently high. It seemed natural to assume that above this temperature these compounds cannot exist. The authors have shown, however, by the investigation of certain compounds of silicium, that this conclusion is too absolute. The sesquichloride of silicium, in particular, very stable at common temperatures, begins to decompose about 350°, and its decomposition is complete at 800°. Yet this same sesquichloride is reformed if the products of its decomposition are brought together in a porcelain tube at about 1200°. The sesquichloride thus formed may be isolated by cooling suddenly. But if it is allowed to arrive slowly into parts of the tube where the temperature does not exceed 800°, it is decomposed anew, yielding crystalline silicium, which blocks up the tube. Similar phenomena have been observed with the protochloride and the subfluoride of silicium. M. Ditte has shown that the hydro-selenic and hydro-telluric acids, so easily decomposed into their elements by heat, may be reproduced from these same elements at a higher temperature (*Comptes Rendus*, lxxiv., p. 980). Platinum heated to about 1400° is neither fusible nor volatile in an atmosphere of nitrogen, oxygen, or hydrogen. But if to the metal thus heated in a porcelain tube in an inert atmosphere we introduce a few bubbles of chlorine there are deposited in the cooler parts of the tube very minute crystals of platinum. The metal thus behaves as if volatile in chlorine. This phenomenon is the result of the decomposition at a lower temperature of a chloride of platinum formed at a higher.

Process for Solidifying Bisulphide of Carbon.—M. Mercier.—If drying oils are treated with a small proportion of protochloride of sulphur they are converted into elastic and transparent solids. If at the moment of making the mixture a volatile liquid soluble in oil is added, such as the sulphide of carbon, the latter is enclosed as in a net, from which it escapes very slowly. The mass may contain as much as 70 per cent of bisulphide of carbon, and is proposed for the treatment of the phylloxera.

Industrial Preparation of Pure Salts of Alumina.—M. Ducla.—Common sulphate of alumina contains always sulphate of iron, which causes it to be rejected by the dyers, and there is also frequently an excess of acid present, hurtful in many cases. The author treats a solution of the common sulphate with a mixture of milk of lime and precipitate carbonate of lime at the ordinary temperature. Sulphate of lime is formed with hydrate of alumina and oxide of iron, while carbonic acid escapes. To separate the alumina the author adds a lye of caustic soda, which forms a soluble aluminate of soda, and runs off the clear solution. Into this liquid is passed the carbonic acid evolved by the action of the carbonate of lime upon sulphate of alumina. Carbonate of soda is formed, and alumina is thrown down. The carbonate of soda is treated with milk of lime, thus regenerating the caustic soda, and obtaining in addition a mixture of milk of lime and precipitated carbonate of lime fit for use in the first operation. Thus alumina is obtained as a pure hydrate, the sole important expense (!) being that of the sulphuric acid converted into sulphate of lime. But it is known that sulphate of lime mixed with waters containing carbonate of ammonia yields sulphate of ammonia and carbonate of lime. This sulphate of lime, then, is as useful in the manufacture of sulphate of ammonia as the sulphuric acid from which it has been formed.

Monochlorated Acetones.—M. Etard.—Not adapted for abstraction.

Experiments Proving that the Septicity of Putrid Blood depends on Ferments of a Definite Shape.—M. V. Feltz.—The author finds that by heating putrid blood to 80°, and triturating the coagulum with distilled water, we may to a certain extent isolate the "infinitely small" bodies, and re-unite them in a liquid which preserves the poisonous properties of the original blood. If the liquid thus obtained is heated to 150° its poisonous properties are removed.

Presence of Mercury in the Spring of the Rocher at Mont Cornadore (St. Nectaire-le-Haut, Puy de Dome).—M. Garrigon.—The water of this spring is very complex, containing the carbonic, sulphuric, silicic, phosphoric, boric, and nitric acids, along with chlorine and iodine, and the following array of bodies:—Soda, potassa,

lithia, ammonia, lime, strontia, baryta, magnesia, alumina, chrome, glucina, iron, manganese, zinc, cobalt and nickel, copper, lead, silver, mercury, arsenic, antimony, and tin. The last mentioned nine metals were estimated 0·0080 grm. per litre of the water.

Fixation of Tannin by Vegetable Tissues.—M. A. Müntz.—Nitrogenous vegetable tissues are susceptible of undergoing the true tanning process if brought in contact with solutions of tannin.

Justus Liebig's Annalen der Chemie,
Band 186, 1877.

Structural Formula of Hydroxylamin and its Amidoid Derivatives. W. Lossen.—A memoir extending to 75 pages, containing much hypothetical matter, and incapable of useful abstraction.

Crystallographic Examination of Amidoid Derivatives of Hydroxylamin.—C. Klein and Ch. Trechmann.—The authors conclude that in these bodies the relative position of the atomic groups in the molecule has a greater influence upon optical properties than upon chemical constitution.

Tri-hydroxyl-antimonic Acid, Pyro-antimonic Acid, and Antimonic Oxychloride.—Dr. H. Daubrawa.—The author endeavours to prove the existence of tri-hydroxyl-antimonic acid, a body assumed by Geuther. He also adduces experiments showing the existence of antimonic oxychloride, $SbOCl_3$.

Communications from the Chemical Laboratory of Greifswald.—These consist of a paper by Alfred Thomas on meta-brom-sulpho-benzolic acid; a memoir by H. Limpricht on the action of bromine upon the sulpho-benzolate and meta-brom-sulpho-benzolate of silver; and a paper by Dr. C. Goslich on a new dibrom-sulpho-benzolic acid.

Nitride of Aluminium, and the Action of Aluminium upon Carbonate of Soda at an Elevated Temperature.—Prof. J. W. Mallet.—In order to ascertain whether aluminium is capable of combining with carbon like iron on its conversion into steel metallic aluminium was very strongly heated along with carbonate of soda. It is maintained that free carbon and aluminate of soda are formed. The result was negative as far as the formation of a definite carbide of aluminium is concerned. The residual aluminium takes up very little carbon, and this little is chiefly, if not exclusively, a mere mechanical admixture, without influence upon the properties of the metal. At very high temperatures the soda is completely reduced and so thoroughly volatilised that spectroscopic examination only shows the soda reaction very faintly if due care be taken to avoid dust, &c. *Nitride of aluminium.*—In all the experiments there were found on the surface and in the cavities of the aluminium regulus small, yellow, crystalline particles and amorphous yellow crusts. These are aluminium nitride. In the amorphous state it is pale yellow, but when crystalline a light honey-colour, and transparent. They were shining and beautifully sharp, not more than 0·2 m.m. in diameter, and so entangled that a microscopic determination of their angles was not practicable. The crystals are brittle, and not hard enough to scratch glass. On exposure to moist air the gradually become sulphur-coloured and opaque, and in about eight to fourteen days they crumble to a white powder of alumina, ammonia escaping. Aluminium nitride is not directly decomposed by water, whether hot or cold. It is decomposed by acids and caustic alkalies, a salt of ammonia or free ammonia being formed while alumina dissolves. The composition of this substance is:—

Aluminium	66·18
Nitrogen	33·82
	100·00

corresponding with the formula Al_2N_2.

Communications from the Laboratory of the University of Würzburg.—These consist of a long memoir "On the Synthesis of Acetic Ester," by J. Wislicenus; a paper on "Acetic Isamylester," by Dr. Max Conrad; and one on "Halogen Substituted Acetic Esters," by the same author.

Behaviour of Various Amylens with Oxidising Agents.—Dr. Franz Zeidler.—The material used for the preparation of the amylens was amylic alcohol, optically inactive. The oxidising agents used in every case were permanganate of potassa, chromic acid, chromate of potassa, iodate of potassa, and nitric acid. The results obtained are described at length.

Behaviour of Certain Ketons with Oxidising Agents.—Dr. M. Hertz.—The ketons submitted to experiment were dimethyl-keton, methyl-propyl-keton, butyron, capron, and palmiton. In addition to bichromate of potassa and free chromic acid, which have been hitherto used in the oxidation of ketons, the author employed permanganate of potassa in neutral, acid, and alkaline solution, silver oxide in presence of bromine, peroxide of lead, and nitric acid.

Communications from the Chemical Laboratory of Greifswald.—These consist of papers "On Tribrom-sulpho-benzolic acid," by Dr. Otto Reinke; on the same subject, by Dr. P. Knuth; and "On Ortho-amido-sulpho-benzolic Acid and Ortho-bromo-sulpho-benzolic acid," by Dr. Ad. Bahlmann.

On Catechin.—Karl Etti.—For the preparation of catechin the author prefers the following method:—Catechin is dissolved in 8 parts of boiling water, strained at once through a cloth, and the solution allowed to stand for some days in the cold. At the expiration of this time catechin, almost insoluble in cold water, is found deposited. It is collected on a linen cloth and pressed very strongly in a screw press. The crude product, still contaminated with catechured, is dissolved in a sufficient quantity of very dilute alcohol. The solution, after settling, is passed through filter paper and agitated with ether as long as catechin is taken up. The ether is then distilled off, the semi-solid residue is taken up in distilled water, the solution is allowed to stand for some days, when catechin crystallises out almost free from colour. It is collected upon a cloth, pressed, and re-dissolved in boiling water, when yellowish white crystals of quercetin remain undissolved. From the filtrate catechin is deposited on cooling in crystalline needles. A saturated aqueous solution of catechin at a gentle heat precipitates albumen, but has no effect upon solution of glue. The aqueous solution is not affected by boiling with zinc and dilute sulphuric acid. The solution of catechin at a boil is unable to expel carbonic acid from the carbonate of baryta. Catechin is probably a compound of a yet unknown tetrahydrised proto-catechuic acid with diphloroglucin.

Dinitro-sulpho-toluolic Acids.—Hugo Schwanert.—Not suitable for abstraction.

Ferrocyanic Compounds.—Dr. Z. H. Skraup.—The author gives an experimental demonstration that the two soluble Prussian blues which he describes, Turnbull's blue and Prussian blue, of the formula Fe_5Cy_{12}, are identical.

Action of Water on the Haloid Compounds of the Alcohol Radicals.—Gustav Niederist.—Iso-propylic iodide is easily decomposed on heating with water in a sealed tube; iso-butylic iodide and chloride less readily, and amylic iodide still less.

Notes on a Treatise by Th. Mehlis ("On Heptylic Acid from Oenanthic Oil and on Certain of its Derivatives," in these *Annalen*, Band 185, p. 358).—C. Schorlemmer.—Dr. Schorlemmer points out certain errors in the memoir in question.

THE CHEMICAL NEWS.

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ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 225.)

136. THE bulb was placed in a box lined with black velvet, apertures being cut to allow the index ray to pass in and out and the experimental light to fall on it. The index ray was passed through diaphragms in cards and a cell of water, to keep the heat from the lamp from acting on the pith. The face of the pith was also protected by black screens from all side radiation, and the path of the experimental ray of light was guarded on each side by a double row of bottles filled with water, and packed at the top and bottom with cotton-wool. Without this precaution I was unable to go sufficiently near the apparatus to observe the movement, without introducing irregularities from the heat of my body. The light was only allowed to shine on the black surface of the pith, a screen shading it from the white half.

The scale (*k*) on which the index ray of light (*g f h*) fell was 5 feet 6 inches from the hanging mirror (*f*). It was divided into millimetres; the measurements given below are the actual movements of the index ray of light along this millimetre-scale. The candle (*k*) was a "parliamentary standard" (109). It was surrounded on three sides with black velvet screens, and an assistant, standing close to it, raised or depressed a black shade in front of it, as I called "light" or "dark," watching the index ray of light at the same time. No one moved during the experiment, and the room was in perfect darkness (except from the candle) and was of a uniform temperature.

Each recorded observation is the mean of three or four. I did not carry the series beyond 35 feet, as that was the greatest distance I could get in my laboratory.

I could not take measurements with the candle nearer than 6 feet, as the index went off the scale. The diagram, fig. 4, shows graphically the above series. The isolated dots show the experimental observations, whilst the continuous lines show the curves which the observations ought to have taken according to the law of inverse squares. The agreement is sufficiently close to prove that the force of radiation varies inversely with the square of the distance of the source. The discrepancies, especially at the greater distances, are considerable. Some are doubtless due to irregular torsion of the silk fibre, to interfering heat which penetrated the screens, to some of the observations following too closely those preceding

Distance between standard candle and pith bar of instrument.	Movement of luminous index on millimetre-scale, 5 ft. 6 ins. from the hanging mirror, in millimetres.	
	With no screen interposed.	With a glass screen, 2 millims. thick, interposed.
Feet.	Millims.	Millims.
35	9·0	6·0
34	13·0	8·0
33	14·0	9·5
32	11·5	7·5
31	13·5	9·0
30	13·5	8·5
29	16·0	10·5
28	14·0	9·0
27	16·5	11·0
26	23·5	15·5
25	18·0	11·5
24	19·5	13·0
23	23·5	15·5
22	23·5	15·0
21	26·0	17·5
20	28·5	19·0
19·5	31·0	20·5
19	32·5	21·5
18·5	33·0	22·0
18	37·5	24·5
17·5	39·5	26·5
17	43·0	28·5
16·5	43·5	28·5
16	45·5	30·5
15·5	50·5	34·0
15	52·5	35·0
14·5	56·0	37·5
14	63·5	42·5
13·5	66·0	44·5
13	71·0	47·5
12·5	78·0	51·5
12	82·5	54·0
11·5	87·5	58·5
11	96·5	64·0
10·5	108·5	72·0
10	114·5	77·0
9·5	133·0	89·5
9	147·0	97·5
8·5	165·0	111·5
8	190·0	125·0
7·5	210·0	138·0
7	244·0	162·5
6·5	279·5	187·0
6	325·0	218·0

FIG. 4.

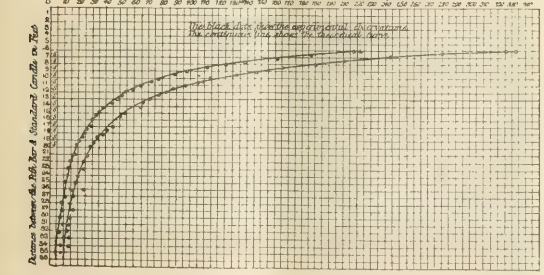
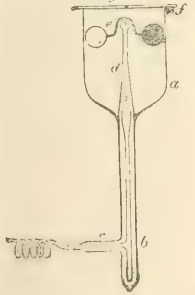


FIG. 5.



* A Paper communicated to the Royal Society, January 5, 1870. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

them, but chiefly to the irregular burning of the standard candle. Indeed this cause alone is sufficient to account for all the discrepancies between theory and experiment; and it would appear to be very active in some cases, as a reference to the diagram will show. The observations with the glass plate in front followed immediately after the corresponding observation with the naked flame, so that if the candle were burning irregularly in one instance it would probably be burning irregularly in the other. The diagram shows the observations to agree pretty well with theory from 6 feet off to 9·5 feet. At 10 feet the action of the naked flame is less than it ought to be, and this is repeated when the sheet of glass is interposed. At 14 feet off the naked-flame observation shows more action than is required by theory, and the observation behind the glass plate is also in excess. The dots at 16, 17, 18·5 22, 24, and 25 feet follow the same rule; where one is in excess or deficient the corresponding one repeats the error. At 26 feet off the candle must have been burning with extra brilliancy, for the action on the pith is as strong as it was when the candle was only 23 feet off; and almost identically the same thing is noticed when the plate of glass is interposed and the corresponding observation taken; at 33 and 34 feet off the same discrepancies occur. Altogether I consider that the comparison of these curves shows that unequal burning of the candle must be credited with most of the discrepancies.

137. This apparatus was now placed so that I could put a candle or other source of light on each side of it; and its sensitiveness was greatly diminished by lowering the controlling magnet. A thin glass screen was placed on each side of the black velvet box containing the bar-apparatus. The scale, divided into millimetres, was placed 5 feet 6 inches from the bar. No screen was put in front of the white half of the pith bar, the movement, under the influence of radiation, being a differential one, due to the superior sensitiveness of the black over the white surface:—

1 candle,	48 ins.	from bar,	(deflected	the)	· 90	m.m.
			(luminous	index)		
2 candles,	48	,,	,,	,,	· 177	,,
2 ,,	72	,,	,,	,,	· 98	,,
1 candle,	72	,,	,,	,,	· 50	,,
1 ,,	36	,,	,,	,,	· 180	,,
3 candles,	72	,,	,,	,,	· 160	,,

These results are sufficiently close to theory for the differences to be accounted for by variations in the light of the candle used.

138. A candle was placed 36 inches from the bar, and the deflections of the index were taken, after various screens were interposed in the path of the light (109):—

Candle, naked flame			180 m.m
Do. shining through yellow glass..			161 ,,
Do. ,, ,,	blue glass		102 ,,
Do. ,, ,,	green glass		101 ,,
Do. ,, ,,	red glass..		128 ,,
Do. ,, ,,	40½ m.m. greenish glass		125 ,,
Do. ,, ,,	81 ,, ,, ,,		99 ,,
Do. ,, ,,	3½ m.m. of water in cell		48 ,,
Do. ,, ,,	7½ ,, ,, ,,		47 ,,
Do. ,, ,,	alum plate 5 m.m. thick		27 ,,

139. A candle was now placed on the left side of the bar, 48 inches off. The luminous index moved 95 millimetres. Another candle was placed on the right side of the bar, 48 inches off. It drove the index back to zero, and, after a few oscillations, kept it stationary a few millimetres the other side of it. I moved the right-hand candle 49 inches off, and the index soon stood steadily at zero. By shading off either of the candles the index ray instantly moved 95 millimetres one side or the other. This gives a ready means of balancing two sources of light one against the other. Thus, retaining the standard candle 48 inches off on the left of the bar (deflection of index = 95 millims.), the index was brought to zero by

2 candles, on the right	67 inches off.
1 candle, behind solution of sulphate of copper 7½ millims. thick.. ..	6 ,,
1 candle, behind alum plate 5 millims. thick	14 ,,
A small gas-flame (bat's-wing) ..	113 ,,

140. These experiments show how conveniently and accurately this instrument can be used as a photometer. By balancing a standard candle on one side against any source of light on the other the value of the latter, in terms of a candle, is readily shown; thus, in the last experiment, the standard candle 48 inches off was balanced by a small gas-flame 113 inches off. The lights were therefore in the proportion of 48^2 to 113^2; or as 2304 : 12,769, or as 1 : 5·5. The gas-burner was therefore equal to 5½ candles.

By interposing screens of water or plates of alum, and so cutting off all the dark heat, the actual luminosity is measured. In addition to this, by interposing coloured glasses or solutions, any desired colours can be measured, either against the total radiation from a candle, its luminous rays, or any desired colour. One coloured ray can be balanced against another coloured ray by having differently coloured screens on either side. If one screen is a cell of iodine in disulphide of carbon, dark heat can be balanced on one side against light and colour on the other side (109, 110).

Again, the variations in the luminosity of a "standard" candle will cease to be of importance. Any candle may be taken, and if it be placed at such a distance from the bar as to give a uniform deflection (say 100 millims.), the standard can be reproduced at any subsequent time; and the burning of the candle may be tested during the photometric experiments by taking the deflection it causes from time to time, and altering its distance, if needed, to keep the index at 100 millims.

141. When a strong light is brought near this apparatus the bar receives an impulse which, unless the magnetic control is very strong, spins it round and round several times. If two strong lights are presented to it on opposite sides the bar oscillates rapidly from one to the other. As the lights are withdrawn to a greater distance the oscillations get smaller, until the bar settles down to a fixed position, dependent on the relative intensities of the lights shining on it.

142. Another instrument was constructed like the one last described (135), but the pith bar was blacked on alternate halves, instead of having the same half blacked on each side. By this construction an impetus given to the bar by a beam of radiation would always act in the same direction of movement, the right half of the pith surface presented to the light being always black, and the left half of the pith always white, so that, if the impulse were strong enough to carry the bar beyond the dead centre, continual rotation would be produced. Experiment fully confirmed this supposition. When even imperfectly exhausted, the suspended bar rotated when a candle was brought near it; and after more complete exhaustion it spun round rapidly, under the influence of radiation, so that the suspending fibre was twisted up, and ultimately stopped the movement by the accumulated torsion.

143. Were the black and white surfaces mounted on a pivot, like a compass-needle, instead of being suspended on a silk fibre, the movement would not be stopped by torsion. The friction, however, would possibly interfere. To test this an apparatus was fitted up, as shown in fig. 5. *a* is a glass vessel open at the top, and attached to a hollow glass stem (*b*), which is sealed up at the the lower end. At the side of *b* a tube (*c*) is attached, which is connected by the glass spiral to the mercury-pump. To the hollow stem a piece of glass tube (*d*) is cemented by fusion so as to remain fixed in the position shown. The upper part of *d* is drawn somewhat narrow before the blowpipe, and in it is cemented a small cup-shaped ruby. The top of the vessel *a* is ground quite flat, and a ground-glass cover (*f*) can be cemented on (83). The movable

part of the apparatus is shown at *e*; it consists of a fine curved brass wire with a needle-point soldered to the centre, and having a very thin disk of pith, half an inch in diameter, cemented on to each end. Each disk of pith is lampblacked on one side and plain white on the other, and they are fastened on so that one black and one white surface is always visible. The movable arms are balanced so that they turn easily to the slightest impulse when the needle rests in the cup. The apparatus being arranged as shown, the cap is cemented on and the whole is exhausted.

(To be continued.)

THE ACTION OF ARSENIOUS HYDRIDE UPON THE ACIDS.

By HENRY B. PARSONS, Ph.C.

ARSENIOUS hydride is a reducing agent of moderate power. It reduces nearly all the acids that are reduced by hydro-sulphuric acid, but, in most cases, the reaction is not as rapid or as complete. The principal reference-books, printed in the English, give very little authority as to the action of arsenious hydride on the inorganic acids. In some cases only one of the products is stated, and in other cases authorities differ. Gmelin's "Handbook of Chemistry" and Watts's "Dictionary of Chemistry" state the action of arsenious hydride upon nitric and sulphuric acids, and upon the elements chlorine, bromine, and iodine; but further than this they do not go.

Having spent some time in experimenting upon the action of arsenious hydride upon the inorganic acids more commonly employed in analysis, I submit my results, methods of analysis, and equations in explanation of reactions observed.

The arsenious hydride was generated by action of zinc and excess of sulphuric acid upon alkaline (KHO) solution of arsenious oxide. A larger amount of arsenious hydride is produced than by action of zinc upon hydrochloric acid solution of arsenious oxide. The gas was washed through distilled water.

Unless otherwise stated, the solutions, when treated with the gas, were at the temperature of the room,—about 23° to 25° C.

Several methods were employed in the detection of arsenic, and in distinguishing between arsenious and arsenic oxides. I will state briefly each process, and will refer to it when explaining reactions, thus avoiding needless repetition.

When any precipitate was formed it was removed by filtration and immediately analysed. The clear filtrate was next examined.

In no case was a single test depended upon where others could be employed. The following were the processes most used:—

METHODS OF ANALYSIS.

Method *a*.—The clear solution, after removal of any precipitate caused by arsenious hydride, was placed in a "Marsh's apparatus," with zinc and sulphuric acid, both free from arsenic, and the gas thus formed was passed into a solution of argentic nitrate. If any precipitate was formed it was filtered out, the filtrate acidulated with hydrochloric acid, to remove undecomposed argentic nitrate, filtered, and treated with hydro-sulphuric acid. A yellow precipitate of arsenious sulphide indicated arsenious or arsenic oxides in the solution. A delicate method.

Method *b*.—In absence of excess of oxidising agents, as nitrates, chlorates, chromates, &c., the sodium-amalgam test* proved very delicate, convenient, and satisfactory.

Method *c*.—If the presence of arsenic was proved by methods *a* and *b*, the original solution was tested to ascertain whether arsenious oxide, or arsenic oxide, or both were present. The prompt formation of arsenious sulphide, by action of hydro-sulphuric acid gas upon cold acidulated solutions, was accepted as evidence of *arsenious oxide*.

Method *d*.—To the original solution was added potassic permanganate. In absence of other reducing agents, a reduction to manganate and oxides of manganese was accepted as confirming the presence of *arsenious oxide*. Tolerably delicate, but not as generally applicable as *c*.

Method *e*.—After removal of *arsenious oxide* by method *c* the filtrate was treated with sulphurous anhydride, or with sodic sulphite and excess of hydrochloric acid. The solution was warmed, and any excess of sulphurous anhydride removed by heat; the liquid was then treated with hydro-sulphuric acid. A precipitate of arsenious sulphide was accepted as evidence of *arsenic oxide* in the original solution. In no case was a precipitate of *sulphur* mistaken for arsenious sulphide. Any yellow precipitate formed was oxidised to arsenic oxide by chlorine or nitric acid, and then treated by method *a* or *b*.

Method *f*.—To the original solution was added potassic acetate, excess of acetic acid, and uranic acetate. In absence of phosphoric acid, a yellowish white precipitate indicates *arsenic oxide*.† Very delicate and distinctive.

Method *g*.—To the original solution was added ammonic chloride, ammonic hydrate, and magnesic sulphate. In absence of phosphates a white precipitate was taken as evidence of *arsenic oxide*. Not so delicate as method *f*.

Method *h*.—In absence of interfering acids the colour of the precipitates caused by ammonio-argentic nitrate served as an indication as to the presence of arsenious or arsenic oxide.

EXPERIMENT I.

Action upon Oxalic Acid.—No reaction.

No arsenic was detected by methods *a*, *b*, *c*. The oxalic acid was unchanged, no carbonic oxide or carbonic anhydride being evolved.

EXPERIMENT II.

Action upon Nitrous Acid.—Forms arsenious and arsenic oxides and nitric oxide.

Potassic nitrite solution was carefully acidulated with cold, dilute sulphuric acid, so that no red fumes were evolved. Upon treatment with arsenious hydride red nitrous fumes were freely liberated, showing reduction of nitrous anhydride to nitric oxide. Much arsenious hydride escaped unchanged. Arsenious oxide in slight amount, and arsenic oxide in much larger quantity, were present in the solution. Probably arsenious oxide was first formed, then oxidised to arsenic oxide by the free nitrous and nitric acids present (methods *c*, *e*). The following equation probably explains the reaction:—

$$12KNO_2 + 6H_2SO_4 + 2AsH_3 = -As_2O_3 + 12NO + 6K_2SO_4 + 9H_2O.$$

EXPERIMENT III.

Action upon Hydro-sulphuric Acid.—No reaction.

Both gases were passed into water. After warming, to remove free gases, all the tests were applied, but no arsenic was detected. Probably these gases will not combine and neutralise each other when diffused in the atmosphere.‡

EXPERIMENT IV.

Action upon Thio-sulphuric Acid.—In neutral and alkaline solutions no reaction.

When acidified the reaction would be the same as in the case of sulphurous acid (see Experiment V.), owing to change of thio-sulphates, by acidulation, into sulphur, sulphurous anhydride, and salt of the mineral acid employed.

EXPERIMENT V.

Action upon Sulphurous Acid.—Forms a *very scanty* red-brown precipitate containing metalloidal arsenic, and

* E. W. Davy, CHEMICAL NEWS, vol. xxxiii., p. 58.

† F. Heppe, "Chem. React."

‡ CHEM. NEWS, vol. xxxiv., pp. 68, 81, 132, 161.

a sulphide of arsenic, which was entirely insoluble in ammonic carbonate solution, easily soluble in yellow sulphide of ammonium, and gave reactions for arsenic oxide after treatment with nitric acid.

I was unable to obtain enough of the brown precipitate for a quantitative examination, but suppose it to be a "lower sulphide," as As_8S_7. Nearly all the arsenious hydride escaped unchanged.

EXPERIMENT VI.

Action upon Hydro-ferrocyanic, Hydro-ferricyanic, and Sulphocyanic Acids.—No reaction.

Proved by methods *a*, *b*, *c*, *e*, *f*.

In the case of potassic ferricyanide in alkaline (KHO) solution a seeming reduction to ferrocyanide occurred, but the solution contained no arsenic. I find that if potassic ferricyanide be heated, with excess of potassic hydrate on the water-bath, for two hours, it will be changed, wholly or in part, to potassic ferrocyanide.

EXPERIMENT VII.

Action upon Hydrochloric, Hydrobromic, and Hydriodic Acid.—No reaction, as proved by methods *a*, *b*, *c*, *e*, *f*.

The hydrochloric acid used was Fresenius's reagent, sp. gr. 1·12, containing 24 per cent HCl.

EXPERIMENT VIII.

Action upon Hypochlorous Acid.—Forms arsenious and arsenic oxides, and hydrochloric acid.

Freshly-prepared solution of sodic hypochlorite, containing excess of sodic carbonate, was used, and the reaction proved by methods *c*, *e*, *f*. Arsenic oxide was in excess of arsenious oxide. Probably arsenious oxide was first formed, then changed to arsenic oxide by excess of hypochlorite,—

$$6NaClO + 2AsH_3 = 6NaCl + As_2O_3 + 3H_2O.$$

EXPERIMENT IX.

Action upon Chloric Acid.—

1. In neutral or acid solutions, no reaction. Baric or potassic chlorate treated with cold, dilute, sulphuric acid, then with the gas, were unchanged after eight hours. Proved by methods *a*, *b*, *c*, *e*, *f*.

2. In alkaline solutions elemental arsenic is precipitated and potassic chloride formed. The potassic chlorate and potassic hydrate used were free from potassic chloride.

The arsenic was precipitated as a dark brown flocculent mass, insoluble in hydrochloric acid, soluble in nitric acid, and hypochlorite, to form arsenic oxide. The filtrate, after removal of arsenic, contained no arsenious or arsenic oxides, as proved by methods *a*, *b*, *c*, *e*, *f*. Much arsenious hydride escaped unchanged. The following equation explains the reaction :—

$$KClO_3 + 2AsH_3 + n KHO = KCl + As_2 + n KHO + 3H_2O.$$

EXPERIMENT X.

Action upon Iodic Acid.—Forms iodine and arsenious oxide.

After removal of free iodine by carbon disulphide the arsenious oxide was proved by method *c*, and the absence of arsenic oxide by method *e*. The following is the equation :—

$$12HIO_3 + 10AsH_3 = 6I_2 + 5As_2O_3 + 21H_2O.$$

EXPERIMENT XI.

Action on Hypophosphorous Acid.—No reaction in neutral or acid solutions. Proved by method *a*.

When treated in "Marsh's apparatus," with zinc and dilute acid, the gas generated caused a black precipitate of metallic silver when passed into argentic nitrate solution. The filtrate, after removal of silver salt, contained phosphoric acid; no arsenious oxide.

EXPERIMENT XII.

Action upon Permanganic Acid.—

1. A neutral solution of potassic permanganate contains arsenic oxide, and a brown precipitate, probably manganic hydrate, $Mn_2O_2(OH)_2$.

2. In acid (H_3PO_4 or H_2SO_4) solutions, arsenious and arsenic oxides and manganous salt were formed.

3. In alkaline (KHO) solutions, arsenious and arsenic oxides and brown hydrated oxide of manganese.

In these reactions all the methods of proof were employed. I think that in all these cases arsenious oxide was first formed, then oxidised, more or less completely, by excess of permanganate to arsenic oxide. Thus in acid solutions :—

$$2H_2Mn_2O_8 + 5As_2O_3 = 4MnO + 5As_2O_5 + 2H_2O.^*$$

In alkaline solutions :—

$$H_2Mn_2O_8 + 2As_2O_3 = Mn_2O_3 + 2As_2O_5 + H_2O.$$

The action of arsenious hydride upon permanganate, in presence of free mineral acid, may be stated thus :—

$$6H_2Mn_2O_8 + 10AsH_3 = 12MnO + 5As_2O_3 + 21H_2O.$$

In neutral or alkaline solutions :—

$$3K_2Mn_2O_8 + 4AsH_3 = 3Mn_2O_2(OH)_2 + 2As_2O_3 + 6KHO.$$

The oxidation of arsenious hydride by potassic permanganate is quickly accomplished, in solutions neutral, acid, or alkaline.

The precipitated brown oxides of manganese varied in colour slightly in different experiments, and possibly some manganese dioxide may have been formed.

EXPERIMENT XIII.

Action upon Chromic Acid.—

1. In neutral and acid solutions of potassic acid chromate, no reaction after eight hours' treatment with the gas. Proved by methods *a*, *c*, *e*.

2. In alkaline (KHO) solutions a slow precipitation of chromic hydrate and elemental arsenic occurs.

The precipitate was treated with dilute hydrochloric acid to remove the chromic hydrate, and the remaining arsenic was dissolved in nitric acid to form arsenic oxide. After removal of the precipitate the solution sometimes contained a trace of arsenious oxide; possibly this may have been due to a secondary action of the chromic acid upon precipitated arsenic. The following equation explains the principal reaction :—

$$2K_2CrO_4 + 2AsH_3 + n KHO = As_2 + Cr_2H_6O_6 + (n+4)KHO$$

RECAPITULATION.

Arsenious hydride causes the following changes :—

Oxalic Acid.—No reaction. Experiment I.

Nitrous Acid.—Arsenious and arsenic oxides and nitric oxide. Exp. II.

Nitric Acid.—Arsenious and arsenic oxides and nitric oxide.†

Hydro-sulphuric Acid.—No reaction. Exp. III.

Thio-sulphuric Acid.—No reaction. Exp. IV.

Sulphurous Acid.—Elemental arsenic, and probably a "lower sulphide" of arsenic. Exp. V.

Sulphuric Acid.—Elemental arsenic and sulphurous anhydride.† Later, arsenious oxide and hydro-sulphuric acid.‡

Hydro-ferrocyanic Acid.—No reaction. Exp. VI.

Hydro-ferricyanic Acid.—No reaction. Exp. VI.

Sulphocyanic Acid.—No reaction. Exp. VI.

Chlorine.—Arsenious and arsenic oxides and hydrochloric acid.†

Hydrochloric Acid.—No reaction. Exp. VII.

Hypochlorous Acid.—Arsenious and arsenic oxides and hydrochloric acid. Exp. VIII.

Chloric Acid.—In neutral and acid solutions, no reaction. In alkaline solutions, elemental arsenic and hydrochloric acid. Exp. IX.

* Douglas and Prescott's "Qual. Anal.," 2nd ed., paragraphs 199 and 387.

† Gmelin's "Handbook of Chemistry," vol. iv., p. 266.]

‡ Watts's "Dictionary of Chemistry."

Bromine.—Arsenious and arsenic oxides and hydrobromic acid.*
Hydrobromic Acid.—No reaction. Exp. VII.
Iodine.—Arsenious oxide and hydriodic acid.*
Hydriodic Acid.—No reaction. Exp. VII.
Iodic Acid.—Arsenious oxide and iodine. Exp. X.
Hypophosphorous Acid.—No reaction. Exp. XI.
Permanganic Acid.—1. In neutral solutions, arsenic oxide and manganic oxide. 2. In acid solutions, arsenious and arsenic oxides and manganous salt. 3. In alkaline solutions, arsenious and arsenic oxides and manganic oxide. Exp. XII.
Chromic Acid.—1. In neutral and acid solutions, no reaction. 2. In alkaline solutions, elemental arsenic and chromic oxide.

Chemical Laboratory, University of Michigan,
April 24, 1877.

ACTION OF ALUMINIC IODIDE ON GLYCERIN.

It has been shown by Gladstone and Tribe that the principal end product of the action of aluminium and iodine on alcohol is the same as the product from the action of phosphorous iodide, namely, ethyl-iodide, the intermediate product, aluminic iodo-ethylate,—

$$Al_2\left\{\begin{matrix}(C_2H_5O)_3\\ I_3\end{matrix}\right\}$$

splitting up at a high temperature into ethyl-iodide and aluminic oxide. While working on ethyl-hydrine—

$$[(C_3H_5Ho)(C_nH_{2n+1}O)_2],$$

it occurred to me to try the action of the aluminium-iodine couple on these bodies, namely, mono- and di-äthylin. The action of the couple on these bodies is very energetic, and the products somewhat numerous, so that I thought it better to study in the first place the action of the Al I on glycerin, $C_3H_5(HO)_3$. Glycerin, heated for some hours to expel water, was heated in a retort with aluminium foil, and iodine gradually added. The reaction takes place very slowly at first, but rapidly, with much frothing, at 200°. Hydrogen was evolved, and strongly smelling of acrolein substances, and an oily liquid containing iodine passed over into the receiver. The residue left in the retort at a temperature above 360° is very thick and viscous, but yields a further quantity of oily distillate when heated to nearly redness.

The oily liquid, which quickly became coloured by iodine, was washed with, and separated from, water, then dissolved in alcohol, and shaken with mercury, with which it combined with heat-evolution to a yellow body soluble in warm alcohol, from which the mercury allyl compound thus formed separated in crystals on cooling—brilliant, nearly white scales, turning rapidly yellow, C_3H_5HgI, allyl-mercury-iodide.

The alcohol from which the mercury compound was precipitated gave no precipitate when mixed with water, showing absence of isopropyl-iodide.

The end reaction of Al_2I_6 on $C_3H_5(HO)_3$ may therefore be thus shown—

$$2\left\{\begin{matrix}CH_2OH\\ CH\ OH\\ CH_2OH\end{matrix}\right\}+Al_2I_6=\left\{\begin{matrix}CH_2\\ CH\\ CH_2I\end{matrix}\right\}_2+Al_2O_3+6OH_2+2I_2.$$

corresponding to the phosphorous iodide reaction. If a reversed condenser were used it is probable that isopropyl-iodide would also be formed by the further action of HI. In my experiment the allyl-iodide was distilled off as fast as formed. It is probable, of course, that an intermediate body,—

$$\begin{matrix}CH_2O\\ CH\ O-Al-Al\equiv I_3.\\ CH_2O\end{matrix}$$

corresponding to $(C_2H_5O)_3Al_2I_3$, may be formed and destroyed again by the high temperature.

On the ethylin and Al_2I_6 and the action of Al_2I_6 on some aromatic fatty acid ethers further. In the rough experiment referred to 40 grms. iodine gave about 45 to 48 crude iod-allyl.

W. R. H.

Würzburg, May, 1877.

* Gmelin's "Handbook of Chemistry," vol. iv., p. 266.

OFFICIAL SCIENTIFIC WORK IN CANADA.

The official appreciation of scientific knowledge in our Colonies is admirably shown by the official reports recently issued by Colonel A. Brunel, the Commissioner of Inland Revenue for Canada. These are reports on weights and measures, and on the analysis of gas and food.

For the maintenance in Canada of the British standards of length and weight, and for the issue to the local authorities, as well as to chemists and physicists there, of precise copies of these standards, there has been established at Ottawa a department under proper scientific direction, and provided with apparatus of the highest class.

This department has also the appointment and control of the Inspectors whose duty it is to inspect the trade weights and measures. These numerous Inspectors are provided with weighing and measuring apparatus of the best design, furnished by Messrs. Troughton and Simms, L. Oertling, F. W. Hartley, and J. J. Griffin and Sons, of London, and Whitworth and Co., of Manchester. In this respect, indeed, Canada has followed Germany and France rather than the mother country, whose local officers as a rule are provided with the rudest and cheapest instruments, and whose technical knowledge is often of the barest description. A sure evidence of the continued material progress of a country is shown by its appreciation of scientific knowledge as applied to accurate measurement.

From Colonel Brunel's report it appears that—"The analysis of gas and food is being carried out in the Dominion in accordance with the latest scientific experience. The analysts are Prof. Larne and Drs. Edwards and Ellis, and we are glad to see that the department has also had the advice of Prof. Croft. In reports of the analysts will be found much interesting matter relating to the detection of adulterants in food and gas.

In Canada, as elsewhere, condiments, coffee, and milk appear to be largely and unwholesomely adulterated. A comparative analysis of the milk sold in Canada and this country gives the following results :—

Town.	Authority.	Total Solids.	Fat.	Solids not Fat.
London	Mr. Wanklyn ..	12·50	3·20	9·30
Edinburgh	Dr. Macadam ..	12·04	2·44	9·60
Dublin	Dr. Cameron ..	13·00	4·00	9·00
Montreal	Dr. Girdwood ..	15·20	3·16	12·04
Toronto	Dr. Ellis	12·78	3·03	9·55

Quinine wine, which is an article of great demand in Canada, is found as sold to be a highly alcoholised wine containing gentian and *nux vomica*, with 20 per cent of alcohol, and is therefore a powerful stimulant instead of being a simple tonic.

As the department at Ottawa has shown by its reports how much public good it is doing in the detection of adulterants in foods, it is to be hoped that the large cities throughout the Dominion will be soon provided with analysts.

The testing of gas supplied for lighting and heating purposes is also the duty of the Department at Ottawa, and for this purpose chemists have been appointed, and a large quantity of photometric apparatus obtained from Mr. Sugg, of Westminster. The law appears, however, scarcely to have come yet into active operation, and we regret to see that it is at present deficient in relation to the inspection of the illuminating power of gas.

We are glad to hear that Colonel Brunel has been so well supported in the difficult task he has initiated, and we trust that his Department may be imitated in other of our Colonies and Dependencies.

ANALYSES OF IRON ORES, LIMESTONES, COALS, &c., USED IN THE IRON MANUFACTURE IN SCOTLAND.

By WILLIAM WALLACE, Ph.D., F.R.S.E., F.C.S., Public Analyst for Glasgow, &c.

(Continued from p. 110).

TABLE V.—MAGNETIC IRON ORES.

Constituents.	I. Irish.	II. Portuguese.	III. Marbella.	IV. Titanic (Swedish).	V. Iron Sand (N. Zealand).	VI. Monges (Portugal).	VII. Monges.	VIII. Monges.
Peroxide of Iron	70·73	70·44	72·86	54·00	59·43	67·52	62·85	59·71
Protoxide of Iron	26·74	18·00	15·94	28·29	23·14	7·09	7·20	8·81
Oxide of Manganese	trace	0·04	..	—	—	trace	trace	1·48
Lime	—	..	..	..	—	0·66	—	trace
Magnesia	traces	..	0·09	..	..	trace	0·67	trace
Carbonic Acid	..	..	..	..	..	0·46	0·63	—
Phosphoric Acid	0·02	trace	0·01	..	trace	0·08	0·14	0·06
Sulphur	0·18	2·38	0·25	—	0·16	—	—	0·17
Iron combined with Sulphur	0·16	2·08	0·22	—	0·14	—	—	0·15
Titanic Acid	—	—	—	13·50	8·80	—	—	—
Alumina	0·30	1·22	2·16	0·96	4·77	4·70	5·49	7·17
Silica	0·92	2·76	2·72	3·05	3·56	10·83	11·72	16·20
Water, combined	0·95	3·08	5·75	0·20	—	8·66	11·29	6·25
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Iron	70·47	65·48	63·62	59·80	59·75	52·78	49·60	48·80
Specific Gravity	4·335	4·166	4·348	4·762	5·000	—	—	—

(To be continued).

ON THE PRECIPITATION BY AMMONIA OF PHOSPHORIC ACID IN PRESENCE OF LIME, BARYTA, MAGNESIA, ALUMINA, AND FERRIC OXIDE.

By M. H. PELLET.

Baryta and Lime.—Solution containing 1 grm. of phosphoric acid, lime in quantity insufficient to form tricalcic phosphate, baryta in sufficient quantity to saturate all the phosphoric acid. On adding ammonia we have a precipitate containing all the lime in the state of tribasic phosphate. The excess of phosphoric acid is combined with the baryta.

Baryta and Magnesia.—On placing under the same conditions magnesia and baryta, the ammonia gives at first $PO_5 2MGO,HO$, and then phosphate of baryta.

Lime and Magnesia.—In substituting in the experiment No. 1, magnesia for baryta, the ammonia precipitates phosphate of lime, and afrerwards the excess of phosphoric acid is combined with magnesia. Finally in a mixture containing 3 parts of PO_5, lime saturating half of this acid, magnesia saturating one-third, and baryta in excess, we shall have on adding ammonia all the lime in the state of $PO_5 3CaO$, the magnesia as $PO_5 2MgO,HO$, and the excess of phosphoric acid as phosphate of baryta. If we have phosphoric acid with lime, baryta, and magnesia, alumina, and oxide of iron, each of the bases being able to saturate the phosphoric acid, the ammonia will give tricalcic phosphate, alumina, and ferric oxide. As a quantitative assay we have made the following :—

(1.) Phosphoric acid, 1 grm. CaO and MgO in excess, then ammonia. The precipitate collected on a filter and calcined weighed 2·165, corresponding to 0·991 grm. PO_5 (calculating the phosphoric precipitate as $PO_5 3CaO$).

(2.) Phosphoric acid .. .. 2·000 grms.
Lime .. .. 0·525 ,,
Magnesia .. .. 0·882 ,,
Precipitate formed .. .. 3·390 ,,

If the precipitate is $PO_5 3CaO + PO_5 3MgO$
the weight should be .. .. $PO_5 3CaO$ = 0·969
$PO_5 3MgO$ = 1·922
2·891

Corresponding to 0·882 MgO.

But if the precipitate is formed of $PO_5 3CaO$ and $PO_5 2MgO$ the total weight ought to be—

$PO_5 3CaO$ — 0·969 = PO_5 0·444
$PO_5 2MgO$ — 2·432 = PO_5 1·556

Total weight 3·401 2·000

To sum up, phosphoric acid in presence of lime, baryta, magnesia, alumina, and iron, mixed with ammonia, gives rise to a precipitate which will be composed of—

(1) $PO_5, 3CaO, Al_2O_3$, and Fe_2O_3;

if all the lime is in excess so as to form with phosphoric acid tribasic phosphate—

(2) $PO_5, 3CaO, PO_5, 2MgO, Al_2O_3, Fe_2O_3$;

if the lime only saturates part of the phosphoric acid—

(3) $PO_5, 3CaO, PO_5 2MgO, PO_5 3BaO, Al_2O_3$, and Fe_2O_3,

if the lime and magnesia together do not saturate the phosphoric acid.—*Bulletin de la Société Chimique de Paris.*

M. JABLOCHKOFF'S ELECTRIC CANDLE.

A LARGE number of visitors, including many of our foremost men of science, assembled at the West India Docks on Tuesday evening to witness certain experiments to be performed with M. Jablochkoff's electric candle. A large majority were, however, doomed to disappointment, as, owing to some mishap with the engine which was to work the magneto-electric machine, the experiments did not commence until close upon 11 o'clock, by which time the audience was reduced to about a score of persons, most of whom were, apparently, officials of the Dock Company. The experiments having necessarily been curtailed we prefer to say as little as possible about them, as there will shortly be a renewal of them, when we trust that the patience of the visitors, to say nothing of the reputation of the projectors, will not again be put to so severe a strain. The experiments as far as they went were perfectly successful. A yard, 150 feet by 70, surrounded by buildings on three sides and covered with an awning was perfectly well lighted with four "candles," pearl type being legible at any part of the covered area. The applicability of the light for illuminating warehouses, wharfs, and ships' decks, as well as its portability within a limited space,

were also well shown. The light is white and soft, although brilliant, and in general tone and quality closely resembles the limelight or the brilliant moonlight of the south of Europe. The light is not perfectly steady, although it does not flicker nearly so often or so violently as the best form of electric lamp with which we are acquainted. We prefer, however, to reserve any fuller criticism until the experiments are repeated in proper form. Suffice it to say that M. Jablochkoff has fully proved that a fairly steady and brilliant light may be produced by his "candle" fully applicable to the purposes we have named. He has also proved that the current from one machine may be divided into several, each available for a single light, which is one of the most important discoveries which has been made with respect to the electric light for some years.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 17, 1877.

Dr. J. H. Gladstone, F.R.S., President, in the Chair.

An extraordinary general meeting was held on May 31; more than 100 Fellows were present.

The President, after reading the letter in accordance with which the meeting was convened, said there were four subjects to be considered; the first was:—The status and functions of the Publication Committee and the present condition of the *Journal* of the Society; he would be glad to hear any remarks on this question.

Mr. Kingzett rose to propose the following resolution:—"That in the opinion of this meeting the Publication Committee should be dissolved and be re-constituted." Up till 1871 the Committee had consisted of four members, the number then was increased to twenty-two; by bye-law 14 the only censorship was vested in the council and in his opinion the Committee should be more directly responsible to the general body of fellows than at present. He proposed that any censorship, henceforth, should be exercised before the papers were read, and would also suggest that a permanent committee of five be appointed. As to the *Journal*, he, after saying how much the Society was indebted to their indefatigable editor, Mr. Watts, would venture to point out that original papers read before the Society ought not to wait five to six months, whilst the space of the *Journal* was taken up by abstracts of doubtful value. In conclusion he would call attention to the delay in the publication and distribution of the *Journal*; last year, for instance, the average interval between the date of publication and that of reception was forty days.

Prof. Odling rose to second Mr. Kingzett's resolution; in his opinion the complaints as to the delay in publication were well founded; he would mention, however, that the Council had already appointed a Committee to promote a speedy and uniform appearance of the *Journal*. He did not think it would be advisable to exercise a censorship on papers before they were read; such a course must cause delay in publication.

Mr. Neison thought that if a paper was worth reading it was worth publishing. As to the delay, Societies in which the plan of censorship before reading was adopted published their papers more speedily than the Chemical Society.

Mr. Pearsall suggested that each author should send in an abstract with his paper, as was the custom in France.

After a few remarks from Mr. Howard and Mr. Friswell,

The President put Mr. Kingzett's motion, which was carried by a large majority.

The second subject considered was "The proper steps to be taken to place the election of Fellows and Associates of the Society on such a footing as will remove the existing dissatisfaction, and especially with reference to the means of securing proper qualifications in the candidates."

Dr. Paul rose to propose the following resolution:—"That in the opinion of this meeting the principles on which the election of Fellows has hitherto been promoted are unsatisfactory and necessitate revision." It was a matter of regret that during the past few months there had been a growing dissatisfaction as to the election of Fellows. He was not wedded to the idea that the title F.C.S. should give any idea as to the chemical ability of its owner, but there was the fact that on the one hand we had an executive body wanting the sinews of war wherewith to carry on the business of the Society, and whose wishes therefore tended to a large accession of Fellows, while on the other many of the present fellows were dissatisfied, and complained that admission into the Society had become too easy; as a result of this feeling several candidates had recently been blackballed. In his opinion the grade of associate would meet the requirements of many; it gave access to the meetings, to the library, and option to purchase the *Journal* at an almost nominal price, and for his part he should like to see all future Fellows elected from those who had been associates a certain time.

Mr. Friswell had much pleasure in seconding Dr. Paul's resolution; there could be no doubt that to the public the title F.C.S. did convey a certain amount of chemical competence; taking this into consideration he thought that admission to the Fellowship had been too indiscriminate, and that persons had obtained admission into the Society merely to use the letters F.C.S. for trade purposes in connection with the advertisement of spirits, building materials, &c., a practice which, though it might seem to some perfectly proper, was, in his opinion, not a desirable method of using the Fellowship of a learned society.

Mr. Tribe moved an amendment to the effect—"That this Society is of opinion that the present system of election to its Fellowship does not promote its interests or sustain its dignity, and that in place of this system the Council of the Society should recommend to the Fellows annually not more than twenty of the more meritorious candidates for election to its Fellowship," and concluded by proposing that the future associates should take the place of the present Fellows, paying the same subscription, having the *Journal*, &c.

This was seconded by Mr. Herbert, who called attention to the fact that a somewhat similar plan had been proposed by a former committee in 1862.

Mr. Hartley thought that there was much looseness in signing up certificates, but objected most strongly to limiting the number of Fellows.

Mr. De la Rue thought the plan of electing candidates as associates and then passing them up was not feasible. He was afraid that it was impossible to prevent an improper use of the title F.C.S.; he would therefore propose a second amendment:—"That, in the opinion of this meeting, the election of Fellows should only take place on certain dates to be fixed by the Council beforehand."

Dr. Roscoe seconded the amendment, and asserted the claims of science teachers as such to be considered worthy of being admitted to the Fellowship of the Society.

Dr. Williamson thought that a great deal of dissatisfaction had arisen from Fellows signing certificates too much out of their knowledge; that from his point of view "personal knowledge" should mean personal acquaintance and intercourse.

Mr. Kingzett suggested that Mr. De la Rue's proposal would be attended with practical difficulties as to time if 50 to 60 candidates had to be ballotted for on one night.

Prof. Odling objected to a spirit of exclusiveness, and thought that the charter was granted to the Society to advance chemical knowledge and not to found a caste of

chemists; he did not at all agree with Mr. Tribe's resolution. Associates would, according to Mr. Tribe's proposition, have the privilege of riding in a second class carriage paying first class fare; rather would he invite anyone interested in chemistry to become a Fellow and take in the *Journal*, and if there was any extra advantage in the letters F.C.S. let him have it and welcome.

Dr. PAUL briefly replied.

Mr. De la Rue's amendment was then put and carried by a large majority; it was then put as an original motion and carried.

Dr. THUDICHUM rose to propose the following resolution:—"That this meeting recommends to the Council that all contributions to the Research Fund which are not mortmained be applied directly in furtherance of original research."

The Treasurer, Dr. RUSSELL, wished to make a short statement. The Fund amounted to nearly £4000; one-half was invested, in accordance with the wishes of the donors, the other was quite free, and the Council was ready to vote the whole of it at once should occasion arise.

Dr. THUDICHUM thanked Dr. Russell for his explanation, and begged to withdraw the resolution.

The fourth subject was the present condition of the Society in reference to its executive and the bye-laws.

Mr. KINGZETT proposed "That in the opinion of this meeting it is desirable that henceforth the Council shall nominate 12 candidates to fill the annual vacancies in the Council." He thought that the Fellows should have some choice of names to fill up the six vacanies instead of having the exact number nominated by the Council.

Prof. ODLING explained at some length the way in which the Council proceeded to select the names, and concluded by stating his firm conviction that the names were selected after a minute enquiry and with every endeavour to obtain a fairly representative body.

Mr. NEISON seconded Mr. Kingzett's motion.

Mr. SPRATLING proposed as an amendment "That this meeting thanks the Council for the frank explanations given on the points that have been discussed, and begs to express its confidence in the action of the Council.

Mr. NEISON rose to protest against Mr. Spratling's amendment as not being a true amendment to the original motion.

At the request of the PRESIDENT the amendment was withdrawn.

Mr. KINGZETT's original motion was then put and lost.

Mr. FRISWELL proposed the adjournment of the meeting; the proposition was, however, lost.

Mr. SPRATLING's amendment was then put as an original motion, being seconded by Mr. NEISON, and carried unanimously.

The meeting terminated with a hearty vote of thanks to Dr. Gladstone for presiding.

In the course of the meeting it was stated that the Council had under their consideration various alterations in the *Journal*, election of Fellows, &c., and intended shortly to call a general meeting to consider them.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

May 28th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

A REPORT was given from the Executive Committee entrusted with the fund for the erection of memorials to Liebig; the reception of contributions has now ceased. The sum of £5750 has been received for the statute in Munich, and £1200 for that in Giessen.

Prof. A. W. HOFMANN presented a communication "*On the Poly-sulph-hydrate of Strychnine.*" A number of years since he described a compound obtained by the action of an alcoholic solution of $(NH_4)_2S$, containing free S, on strychnine, to which he assigned the formula $C_{21}H_{22}N_2O_2,H_2S_3$, *i.e.*, a union of 1 mol. strychnine and 1 mol. of a supposed hydrogen-trisulphide. More recently Schmidt examined the body, and advanced the opinion that it consisted of 2 mols. strychnine and 3 mols. H_2S_2. As the two formulæ differ only by one atom of hydrogen, elementary analysis fails to decide which of the two must be looked upon as representing the true constitution. The discoverer has sought, therefore, to solve the problem by submitting the compound to the action of As_2O_3 dissolved in hydrochloric acid in sealed tubes, determining the amount and composition of the resultant precipitate of As_2S_3 and S. In the cases of the two supposed compounds the decompositions would necessarily be—

$$3H_2S_2 + As_2O_3 = 3H_2O + As_2S_3 + S_3.$$
$$3H_2S_3 + As_2O_3 = 3H_2O + As_2S_3 + S_6.$$

Experiment showed, however, that the precipitate consisted of $As_2S_3 + S_{15}$, and that the reaction was—

$$3H_2S_6 + As_2O_3 = 3H_2O + As_2S_3 + S_{15}.$$

The compound consists, therefore, of 2 mols. strychnine united with 2 atoms of H and 6 of S. Acids disengage from the strychnine compound a colourless oil possessing the odour and the general properties of persulphide of hydrogen, and gradually splitting up like the latter into S and H_2S. All attempts to analyse the compound having hitherto failed, the author leaves it undecided whether it actually contains an acid, H_2S_6, or resembles in constitution of the poly-iodides of the alkaloids, discovered by Bouchardat, and lately minutely examined by Jörgensen (CHEMICAL NEWS, vol. xxxv., p. 197).

Prof. HOFMANN described also a "*Thioformanilide*," $NH(C_6H_5)(CHS)$, obtained as a crystalline product by the action of H_2S on iso-cyan-benzene, C_6H_5NC, and melting at 198°. It is also prepared by allowing H_2S to work on the crude products resulting from the action of chloroform on aniline dissolved in alcoholic potash. Alkalies decompose it under formation of H_2S, CH_2O_2, and $C_6H_5NH_2$.

The following communication have been received from non-resident Members:—

A. CHRISTOMANOS responds to recent criticisms on his article concerning "*Trichloride of Iodine.*"

J. THOMSEN defends, likewise, his theory regarding the formation of chloric acid against Berthelot's criticisms.

C. HEUMANN has investigated the "*Action of Silver Nitrate on Ultramarine*," and finds that the amorphous product which results consists of silver, which is removed by KCy, and ultramarine containing silver in the place of sodium.

K. MERTENS has examined the "*Nitro Derivatives of Dimethyl-aniline.*" Dilute HNO_3 yields a dinitro-dimethyl-aniline, amounting to 50 per chnt of the dimethyl-aniline used, and accompanied by small quantities of an isomer, distinguished from the first by not undergoing decomposition when treated with KOH. Concentrated HNO_3 yields a trinitro derivative.

V. MEYER and F. V. SPITZER announced during the past year the discovery of a new hydrocarbon, "*Aeterebene*, $C_{10}H_{20}$," formed by the action of ethyl-iodide and sodium on terebene-monochloride, and regarded as ethyl-terebene. It is now found that the same compound results when propyl-iodide is used, and the authors consider it to be simply a camphor.

A paper from R. S. DALE and C. SCHORLEMMER, "*On the Formation of Rosaniline from Aurin*," has already been referred to in these columns.

V. MEYER, in a contribution on "*Triethyl-benzyl-ammonium Iodide*," brings additional proof to show, in opposition to the statements of A. Ladenburg that there is no difference between the two bodies $N(C_2H_5)_2C_7H_7 + C_2H_5I$ and $N(C_2H_5)_3 + C_7H_7I$.

C. L. JACKSON in a "*Notice concerning the Base* $C_{13}H_{13}N$ *from Aniline Residues*," states that he regards it as isomeric with the base obtained by T. Carnelly from the reduction of mono-nitro-tolyl-phenyl.

A. CLAUS and H. SCHUNTZ describe a method for the "*Detection of Traces of Anthraquinon.*" The substance to be examined is placed with sodium amalgam in a test-tube, and covered with absolute ether. After shaking a drop of water is added, and if anthraquinon is present a brilliant red colouration is caused, which is especially deep about the amalgam. Contact with air, caused by shaking, causes its disappearance, but it reappears on standing. An addition of alcohol to the amalgam and anthraquinion gives rise to a beautiful green.

A. CLAUS and H. FRANK have examined the "*Action of* KCy *on the Ether of Chloro-maleic Acid*," and find succinic acid to be the result.

L. F. NILSON has obtained by the "*Action of Iodine and Alcohol on the Plato-nitrites*" fine crystalline salts of the general formula $K_2.N_2O_4I_2.Pt$, accompanied by the formation of aldehyd and ethylic nitrite. The new salts receive the name of plato-iodo-nitrites. A new plato-nitrosylic acid, triplato-octonitrosylic acid, $H_4.8NO_2.Pt_3O$, is prepared by the action of H_2SO_4 on barium-plato-nitrite. It crystallises in dark red needles, and yields crystalline salts.

H. B. HILL finds among the "*Products of the Distillation of Wood at a Low Temperature*" noticeable quantities of furfurol, as well as smaller amounts of pyroxanthin.

R. OTTO, H. MEYER, and C. MEIER, "*Preparation of Benzene-sulph-hydrate from Benzene-sulphinic Acid: New Method of Changing Benzene-disulphide into Benzene-sulph-hydrate.*" The authors have previously ascertained that benzene-sulph-hydrate was yielded by treating benzene sulphinate of zinc with zinc-dust and hydrochloricacid. They now find that this reaction produces chiefly benzene-disulphide, $(C_6H_5)_2S_2$. but that by exposing this product to the action of Zn alone, in a solution containing but little free acid, it is changed completely into the zinc salt of benzene-sulph-hydrate,—

$$(6H_5)_2S_2 + Zn = Zn(C_6H_5S)_2,$$

from which the sulph-hydrate is released by acids, and separated by distillation with steam. This new method of preparing sulph-hydrates can also be extended to disulphides containing substituted halogens, which latter are removed by the usual mode of reduction.

C. PAULY, "*Formation of Sulphinic Acids in the Fatty Series from the Chlor-anhydrides of Sulphonic Acids.*" Schiller and Otto's reaction for the formation of aromatic sulphinic acids—by the action of zinc-dust on the chlor-anhydrides of the corresponding sulphonic acids—has been applied with success to the preparation of ethyl-sulphinic acid, $C_2H_6SO_2$, and isobutyl-sulphinic acid, $C_4H_{10}SO_2$.

H. BECKURST finds that by the "*Action of Sulphuric Acid on Toluen*," instead of two, as hitherto supposed, three isomeric toluen-sulphonic acids are produced. The reaction in the cold with fuming sulphuric acid to the anhydride yields toluen-para-sulphonic acid. With ordinary or fuming H_2SO under the influence of heat the ortho and meta acids are obtained in the proportion of 8 to 2, and separated by the varied solubilities of the amides.

C. v. THAN, "*Heat Evolved by the Union of* H *and* O *in Closed Vessels.*" The experiments described are the first of a series set on foot by the Hungarian Academy for the purpose of applying Bunsen's calorimetric method to the settling of chemical questions. Explosions of pure oxy-hydrogen gas took place in the calorimeter under careful observance of volume, temperature, and pressure, as well as condition at the beginning and at the end of the experiment. The results showed that 1 c.c. of oxy-hydrogen gas at 0° and 0·76 m.m. pressure evolved 2·0293 grms. thermal units by combustion to liquid water in a confined space. Whence 1 grm. H evolves 33·982 grm. units on undergoing combustion to water under the above conditions.

O. FISCHER, "*Phthaleins of Tertiary Aromatic Bases.*" The phthalein of dimethyl-aniline is reduced by HKO to its components, phthalic acid and dimethyl-aniline. Nitric acid causes the formation of a yellow, crystalline, explosive hexa-nitro-phthalein of dimethyl-aniline. Reducing agents yield the phthalin which forms with picric acid a characteristic yellow compound.

"*On the Salicein of Dimethyl-aniline.*" The chloride of salicylic acid is found to have the same action as phthalyl chloride on aromatic bases, occasioning the formation of compounds possessing strong colouring properties. Salicylic chloride and dimethyl-aniline react as follows:—

$$2C_6H_4(OH)(COCl) + 2C_6H_5N(CH_3)_2 = C_{30}H_{30}N_2O_4 + 2HCl.$$

The salicein thus formed is amorphous, insoluble in water and ether, but soluble in alcohol, chloroform, and acetic acid. The tinctorial properties surpass those of the corresponding phthalein. It imparts a colour to silk closely resembling that of methyl-green, and forms with acids salts of various shades of green.

"*Mono-benzoyl-dimethyl-aniline.*" This compound, $C_6H_5COC_6H_4N(CH_3)_2$, results from the action of phosphoric anhydride on benzoic acid and dimethyl-aniline in sealed tubes at 180°. It crystallises in rosettes, melts at 38°, and yields a dinitro-derivative as well as bromine compounds.

"*Action of Nitrous Acid on Substituted Acid Amides.*" By this reaction the author has obtained nitrosacet-paratoluide, $C_6H_4(CH_3)N(NO)C_2H_3O$, nitroso-formanilide, $C_6H_5N(NO)CHO$, and nitroso-oxanilide,—

$$C_6H_5HN.CO.CO.N(NO)C_6H_5.$$

These bodies are all yellow, possess low melting-points, explode easily, and cannot be reduced to substituted hydrazines.

RUSSIAN CHEMICAL SOCIETY.

April, 1877.

N. LEY, "*On the Oxidation of the Secondary Oxy-acids of the Glycollic Series.*" The author has ascertained the following regularity in the oxidation of the secondary acids of the α-series, *i.e.*, those in which the group CHOH is united directly with the group COOH. Oxidising agents cause a decomposition of the molecule, consisting in the separation of the carboxyl group as CO_2 or CH_2O_2, having behind an aldehyd, which finally passes over into the corresponding acid. This is found to be true for ethylidenlactic acid, oxybutyric acid, and isopropyl-oxy-acetic acid (prepared from inactive valerianic acid). The author has also prepared α-oxy-acids from caproic, heptylic, and capric acids, all of which, on oxidation, conform strictly to the rule. He has also obtained from optically active valerianic acid an oxy-acid, different from isopropyl-oxy-acetic acid, and evidently identical with methyl-β-oxy-butyric acid.

A. WISCHNEGRADSKY, "*On the Isomery of the Amylens Derived from Fermentation Amyl-Alcohol.*" The amylen obtained by Flavitzky from the iodide of fermentation amyl-alcohol is found to consist of two hydrocarbons, one boiling at 21° to 22°, the other at 23° to 27°. The first is iso-propyl-ethylen, $(CH_3)_2CH.CH..CH_2$, the second possesses the structure $(CH_3)(C_2H_5)C..CH_2$.

A. ELTEKOFF, "*Transformation of Isocrotylic Ethers.*" The methylic and ethylic ethers of isocrotyl-oxide yield by treatment with weak sulphuric acid isobutyl-aldehyd, $(CH_3)_2.C..CH.OCH_3 + H_2O = (CH_3)_2CH.COH + CH_3OH$. The formation of the alcohol could not, however, be established.

J. IWANOFF, "*Action of a Solution of Lithium Chloride on Arable Soil.*" Weighed quantities of carefully analysed earth were mixed in a flask with a solution containing a known amount of LiCl, frequently shaken, and after the lapse of three days filtered. The amount of Li absorbed by the earth and the salts present in the solution were then determined. The results showed that 1000 grms. of earth absorbed on an average 1·72 grms. LiCl, while the solution had dissolved a very nearly equivalent quantity of $CaCl_2$, $MgCl_2$, NaCl, and but traces of KCl. Similar treat-

ment of earth with solutions of KCl and NaCl, showed that the amounts of LiCl and NaCl absorbed were very nearly the same, while much greater quantities of KCl were absorbed under the same conditions.

P. Wreden and B. Znatovicz, "*On Octo- and Hexahydro-naphthalen.*" These two mobile, colourless liquids, boiling at 187° and 197°, are obtained by the action of hydriodic acid and amorphous phosphorus on naphthalen. They easily absorb O from the air.

NOTICES OF BOOKS.

Notes on the Treatment of Mercury in North California. By T. Egleston, Ph.D. Philadelphia: Sherman and Co.

In North California mercury occurs both native and as cinnabar, and is found in serpentine and often associated with chalcedony. The ores contain sometimes from 3 to 10 per cent of the metal, and even larger quantities. The methods of treatment are two—by precipitation and by roasting. In the former process the ore is heated in retorts with lime, when the sulphur, becoming oxidised, combines with the lime, and the mercury is set free. The roasting process—carried on either in retorts, in other furnaces which are not continuous, or in continuous furnaces—consists in volatilising the sulphur and oxidising it, so as to produce free mercury and sulphuric acid, which latter is permitted to run to waste. No assays of the ore are made, the furnace manager judging the minerals merely by inspection. Hence there is little value to be attached to the reports of the percentage of mercury actually secured by the use of different kinds of furnaces. The procedures in use at the principal mines in the State are very fully described, and there are annexed plans and sections both of the "modified Idria furnaces" and of the "Knox furnaces," as in work at the Redington Mine, in Napa County.

The price of mercury at San Francisco has been as low as 35 per cents per lb. At present it is 75 cents, and in August, 1874, it was 1·75 dols.

*The Ammonia-Soda Process in its Application to the Disposal of Gas-Liquors, as patented by Dr. G. Th. Gerlach.** (Reprinted from *Dingler's Polytechnic Journal*, 1877, Bd. 223, p. 82). Augsburg: Cotta.

The author's process is distinguished from the ordinary ammonia-soda process in several points. He effects the best possible utilisation of gas-liquor, and brings continually fresh quantities of gas-liquor into play. The ammonia-soda process, on the other hand, aims merely at the production of soda, and re-converts the sal-ammoniac employed again and again into caustic ammonia.

The sal-ammoniac obtained by decomposing gas-liquor with common salt is in the Gerlach procedure recovered by crystallisation, and not re-introduced into the circuit of the operation as caustic ammonia. Hence there is no loss of ammonia by volatilisation.

No lime is employed, save the trifling quantity used in the distillation of the gas-liquor for the decomposition of non-volatile ammoniacal compounds. No common salt is wasted, but it returns continually into the circuit of the operation. For every equivalent of chloride of sodium employed a full equivalent of soda is obtained as a by-product, which has not been hitherto found practicable in the ammonia-soda process.

The cost of the recovery of the ammonia is saved, as the solution of chloride of ammonium yields crystals of sal-ammoniac on slight evaporation. The production of sal-ammoniac and that of soda is continuous, whilst fresh quantities of gas-liquor are constantly brought into use.

The defects pointed out by practical men in the common ammonia-soda process are the great quantities of solutions to be dealt with, the enormous consumption of coal depending on the continual recovery of the ammonia, and the unavoidable loss of the latter reagent.

The weak side of Dr. Gerlach's process appears to be that the alkali manufacture could only be carried on where a large and constant supply of gas-liquor is available, and that the yield of soda would be necessarily limited by the quantity of a by-product.

* "Der Ammoniak Soda Process in seiner Anwendung bei der Verarbeitung von Gas-wasser. Patent von Dr. G. Th. Gerlach, in Kalk bei Deutz."

CORRESPONDENCE.

DOCTORS' DIPLOMAS.

To the Editor of the Chemical News.

Sir,—I read with interest the communication of A. A. R. (Chemical News, vol. xxxv., p. 65) in answer to my note concerning the sale of doctors' degrees. I have been informed by a good authority that the bogus University of Philadelphia ceased to exist some time ago. Hence, I do not understand how anyone can sell degrees emanating therefrom.

However, as I possibly may be mistaken, perhaps A. A. R. would be so kind as to publish the proof which he has for making the statement that the degrees sold by "Medicus" emanate from the University of Philadelphia. —I am, &c.,

Dr. P. Townsend Austen.

New York School of Mines,
May 15, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 19, May 7, 1877.

Note on the Communications of General Favé on the Theory of Heat.—M. H. Resal.—Quoting the following passage from M. Favé's last paper:—"The *vis viva* necessary to maintain a drop by counter-balancing gravitation," the author exclaims—"A *vis viva* which neutralises another force! Here is a new principle which mechanicians must beware of adopting."

Researches on the Laws of Avogadro and Ampère.—M. A. Wurtz.—The author defends the law of Avogadro against M. H. Sainte-Claire Deville, who had declared it "a pure and simple hypothesis undermined by facts and by arguments of all kinds."

Chemical Researches on the Green Matter of Leaves.—M. E. Fremy.—The author asks what is the constitution of this curious substance, which during the life of leaves seems to play a part in the decomposition of carbonic acid by plants, and which in many of its properties may be compared to the red globules of the blood? Are we to consider it as a single proximate principle or as a mixture of a blue or a green body with a yellow substance? A recent paper by MM. Guillemare and Lecourt contained certain novel chemical facts, which have been verified by a Commission nominated by the Academy. Among these are the solubility of chlorophyll in caustic soda, and the solution of its aluminous lake in phosphate of soda saturated with acid phosphate of lime. To explain these facts the author refers to his former researches tend-

ing to prove that chlorophyll is formed of two proximate principles—a yellow matter which he names phylloxanthin, and a deep bluish green, phyllocyanin. On treating leaves with alcohol of difierent degrees of concentration he found that alcohol at 62 per cent extracted a pure yellow matter, the phylloxanthin, leaving in the organic tissue phyllocyanic acids, the tint of which darkens more and more as the yellow colour is removed. This blue-green compound is extracted by alcohol at 70 per cent. Corresponding experiments performed on the aluminous lake of chlorophyll led to the same results, which were further confirmed by experiments with acid and basic solvents, by means of which the chlorophyli was split up in a manner still more distinct. The author is led to believe that these two colouring matters exist in leaves in a state of simple mixture. On examining the remaining question, *i.e.*, whether the phyllocyanic acid exists in a free state or combined with some base, he finds that the green colouring matter of leaves is a mixture of phylloxanthin and of the phyllocyanate of potassa. It has been observed that when leaves lose their chlorophyll and turn yellow they lose at the same time a great part of the potash which they formerly contained. Still, when leaves fall there may remain in them a small quantity of colouring matter combined with potassa. This salt is unstable: it is destroyed under the influence of ferments, setting the potassa free. M. A. Trécul, from his microscopical observations, concludes that the views of M. Fremy are not sufficiently demonstrated.

Researches on Accidental Double Refraction.—M. J. Macé.—Not adapted for abstraction.

Internal Resistance of Thermo-Electric Currents. M. L. Rolland.—Not adapted for abstraction.

Acid Acetates.—M. H. Lescœur.—With reference to a recent paper by M. Villars (*Comptes Rendus*, April 15, 1877), who infers the existence of a complete series of acid acetates containing water of crystallisation, the author announces that his researches have led him to different results. A cubic acetate of soda may be produced by dissolving the neutral acetate with the aid of heat in suitable proportions of acetic acid, from 30 up to 75 parts, to 100 of water. But the chemical composition of the products thus obtained is variable, and they resemble the different stages of the alteration of the biacetate under the influence of moisture.

Certain Derivatives of Acetyl-acetic Ether.—M. E. Demarcay.—The bodies in question are hexic acid, $3C_6H_8O_2+H_2O$. This compound melts at 123° to 124°. With ferric chloride its solution gives an intense violet colour. Hexenic acid has not been obtained in a state of perfect purity, but its formula appears to be $3C_6H_8O_3+H_2O$. Acetyl-ethyl-acetic and acetyl-methyl-acetic ethers furnish compounds which correspond perfectly with hexic acid. The author names these pentic acid, $3C_5H_8O_2+H_2O$, and tetric acid, $3C_4H_8O_2+H_2O$. Pentenic and tetrenic acids, corresponding to the hexenic, have also been obtained.

Nitro-salicylic Acid.—Dr. T. L. Phipson.—If about 1 grm. of salicylic acid is stirred up in 30 to 40 c.c. of water, 5 c.c. of fuming nitric acid being then added, and the whole is slowly raised to a temperature bordering on ebullition, the salicylic acid dissolves, and the liquid takes a very fine deep red colour—or towards the end of the reaction a reddish brown, whilst a strong odour of *Spiræa ulmaria* is given off. The author finds that a notable quantity of salicylic aldehyd (salicylous acid) is produced.

Action of Poisonous and Antiseptic Vapours on the Fermentation of Fruits.—MM. Lechartier and F. Bellamy.—Apples placed in bottles along with phenol and with cyanide of potassium did not evolve a single bubble of gas during eighty-three days. In presence of camphor 16 c.c. were given off.

Action of Poisonous and Antiseptic Vapours upon the Fermentation of Fruits.—M. U. Gayon.—This author finds that chloroform and ether completely arrest fermentation, whilst the action of bisulphide of carbon is less complete.

Two New Niobates.—J. Lawrence Smith.—The two minerals in question are very rare, and are associated with euxenite and samarskite. The author has named them Hatchettolite and Rogersite. The hardness of the former is 5, and its specific gravity from 4·851 to 4·785. Colour, yellowish brown with a grey opalescence; lustre, resinous; fracture, sub-conchoidal. Its composition is—

Niobic acid	66·01
Tungstic and stannic acids	0·75
Uranic oxide	15·20
Lime	7·52
Yttria and ceric oxide	2·00
Ferrous oxide	2·08
Potassa	0·50
Loss on heating	5·16
Lead	traces
	99·42

It differs from pyrochlore chiefly by containing uranium. Rogersite is composed of

Niobic acid	18·10
Yttria, &c.	60·12
Water	17·41
	95·63

Its hardness is 3·5, and its specific gravity 3·313.

MEETINGS FOR THE WEEK.

SATURDAY, 9th.—Physical, 3. "On Interference Fringes within the Nicol Prism," F. S. P. Thompson, B.Sc. Special General Meeting.
MONDAY, 11th.—Royal Geographical, 8.30.
TUESDAY, 12th.—Photographic, 8.
——— Anthropological Institute, 8.
THURSDAY, 14th.—Royal, 8.30.

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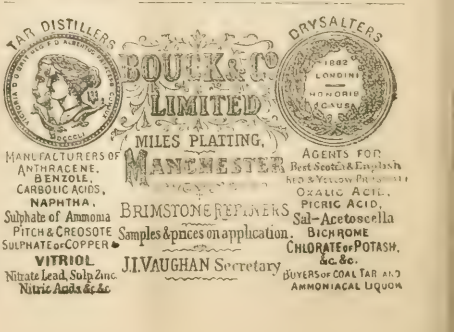


THE CHEMICAL NEWS.

Vol. XXXV. No. 916.

ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 235.)

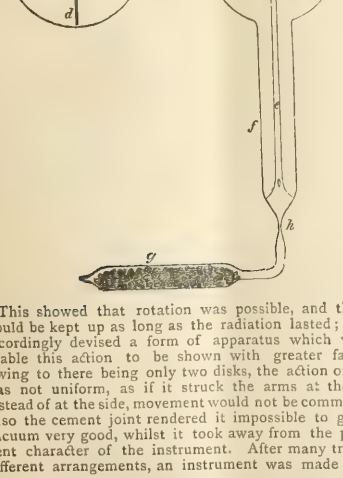
144. When the vacuum is within a few millimetres of being perfect, the arms of this instrument move when a candle is brought near; as the pump continues working rotation commences, which gets more and more rapid, until, with the candle close to the glass, several revolutions are made per second. When well exhausted, the following experiments were tried;—

A flask of boiling water, placed 1 inch from the outer glass, caused the arms to set at right angles to the line joining the flask and the pivot, showing that the heat from boiling water acts on black and white surfaces equally (128).

Copper at 400° C. kept the arms revolving, at first quickly, then slowly, until, as the copper cooled, the rotation stopped, and the black and white surfaces ultimately set equidistant from the hot metal (128).

A candle always set the arms revolving, when it was near enough for the force to overcome the friction.

Fig. 6.



This showed that rotation was possible, and that it would be kept up as long as the radiation lasted; and I accordingly devised a form of apparatus which would enable this action to be shown with greater facility. Owing to there being only two disks, the action of light was not uniform, as if it struck the arms at the end, instead of at the side, movement would not be commenced. Also the cement joint rendered it impossible to get the vacuum very good, whilst it took away from the permanent character of the instrument. After many trials of different arrangements, an instrument was made which had none of these defects, whilst it showed the movement of rotation in a very convenient manner.

145. The apparatus is shown in fig. 6. It consists of four arms, of very fine glass, passing horizontally through pieces of pith (*b*), and afterwards bent twice at right angles, as shown in the figure. Through the centre of the pieces of pith (*b*) is passed vertically the point of a very fine sewing-needle (*a*), which rests in a glass cup (*c*) blown on to the end of the glass tube *e*. At the end of each glass arm is fastened a thin disk of pith, white on one side and lampblacked on the other, the black surfaces of all the disks facing the same way. The whole is enclosed in a glass bulb blown on to the end of a wide tube. *f* is a piece of cement to keep the support (*e*) in its place. *g* is the tube containing cocoanut-shell charcoal; the other end is sealed on to the mercury-pump. The exhaustion is effected as already described (131); and the apparatus is then sealed off, with the charcoal-tube still attached to it. Ultimately, when all the residual gas has been absorbed by the charcoal, a flame is applied to the contracted part of the tube at *h*, and the charcoal-tube is disconnected.

146. Before adopting the above method of making these instruments many experiments were tried, both to secure ease of manipulation and greater delicacy of action. The cup supporting the needle-point was made of ruby, sapphire, chrysolite, aquamarine, and agate; it was, however, found that these offered no advantage over glass, as the friction was not sufficient to produce any abrasion of the glass by the steel point. The disks at the end of the arms were made of every imaginable substance which was likely to answer. Among these I may mention wood, paper, flies' and butterflies' wings, talc, mica, selenite, thin glass, metals of various kinds, ivory, cork, and pith (86). For general purposes I prefer pith, as it is easily cut into slices, is extremely light, dries readily in a vacuum, and does not evolve vapour subsequently; besides which its natural white surface is almost as insensitive to radiation as any substance I have yet examined.

The number of disks has been varied from ten, the maximum which can follow one another without available surface being uselessly obscured, to two, or even one, which latter form has been experimented with, and possesses some advantages. Six disks are a useful number; but as the difficulty of making these instruments increases with the number of arms and disks to be got into the bulb, I prefer four disks for ordinary purposes.

The material of which the arms are made has also been the subject of experiment. My earlier instruments (exhibited at the Soirée of the Royal Society on the 7th of April, 1875) had straw arms. These are, however, too heavy, and are liable to evolve vapour after being kept in the vacuum for some time. An inorganic body is preferable; and I have finally adopted either thin rolled brass or fine glass thread drawn from thermometer tubing.

The colour of the disks has also been experimented on. During this part of the inquiry many curious results have been obtained, which will be described further on. At present, however, I have found nothing better than lampblack for the black surface and the freshly-cut pith for the white surface. In working with cork, metals, &c., where the natural surface is not white enough, oxide of zinc may be used as a coating for the white surface.

147. The lampblack is best applied to the pith surface in the following way:—Camphor is burnt, and a sheet of glass is held close over the flame. An abundant deposit of lampblack takes place. A brush dipped in alcohol is then rubbed over the deposit, and the surface is painted over with the mixture. The lampblack adheres very well to pith, and in a few hours the alcohol and moisture have dried off, and a dead black, very even surface is the result. In some cases I smoke this again over burning camphor; but this is not of much use, unless the first coating shows glistening patches or is not laid on evenly.

(To be continued.)

* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

ON THE

OXIDATION OF GOLD, AND SUPPOSED OXIDATION OF MERCURY BY OXYGEN IN PRESENCE OF WATER.*

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

THIS paper states the results of the investigation I promised at our last meeting relative to the oxidation or otherwise of gold, under circumstances which have not been hitherto supposed favourable for such oxidation. They show, and I think pretty clearly, that this metal *is* oxidised superficially under them, as seems demonstrated by the following facts, which I give as expressing the general results of the very numerous and often-repeated experiments which I have made:—

1. That gold immersed for a few hours in spring water, or in water charged with any neutral salt, refuses for a long time to amalgamate when next immersed in mercury.
2. That it is also passed to this condition by contact for about eighteen hours with distilled water, from which ammonia and other nitrogen compounds have been removed.
3. That it is also thus affected by being placed in contact for a very short time with an aqueous solution of caustic or carbonated alkali or ammonia, at their boiling-points respectively, or for a somewhat longer time when the solution used is at a common temperature.
4. That gold is also passed to this condition when ignited with a weak solution of sodic carbonate.
5. That when put into this condition as to its surface, it becomes readily amalgamable by a short contact with either weak acetic or hydrochloric acid; also, by ignition, except in the case where ignition has been resorted to, to produce this particular condition of such surfaces.

These facts prove, I think, that gold is chemically acted upon when in contact with water or neutral saline solutions charged with oxygen and nitrogen gases, and that this action is facilitated by the presence of alkaline substances, and especially when these are used hot in place of being used cold. It seems to me there can be little doubt entertained but that gold thus acted upon has been oxidised, and this either to a sub oxide or to the purple oxide of gold.

The gold used in these experiments was prepared as pure as possible. Some I twice precipitated by oxalic acid, from very dilute solutions of its chloride.

Other gold I electro-deposited on platinum from its cyanide. Both samples gave similar results, but that obtained by deposition yielded them quicker, owing, perhaps, to the fact of its being coupled with platinum.

There are two circumstances connected with this subject I should relate which puzzled me a great deal, as they hardly seem to tally with certain reactions of this metal as now known. They are—first, that proto-sulphate of iron in contact with gold which has been acted upon by alkaline solutions or water does not render it amalgamable; secondly, that sunlight, even direct, does not appear to exercise any influence in the reaction I have described. Possibly, though, the purple oxide of gold may prove on examination to be invulnerable in these respects.

I may further relate that gold in either argentic nitrate or mercuric chloride rapidly becomes non-amalgamable, but as it is recovered to its former condition by acetic acid, I question whether either of these salts are decomposed here. I further find that pure gold, fused with borax and bisulphate of potash, though very bright, will not amalgamate; the solution of flux was acid. In weak sulphuric acid also gold passes to this non-amalgamable condition.

These results, however, and the question they raise demand investigation, and I hope soon to be able to accomplish this to an extent which will enable me to throw a clear light upon the subject under consideration. Whatever may be the precise nature, however, of the film thus induced upon gold, and of the reactions which result in the removal or alteration of this film as here described, it is certain that films of this kind must cover the surfaces of a portion of our native gold, and thus retard to a more or less extent, its complete amalgamation when milled.

Thus what with the tendency of this metal to enfilm in presence of common water or alkaline solutions in the manner described, and its tendency to become sulphuretted when in contact with soluble sulphides, there can be but little doubt entertained that most of the natural surfaces of native gold are varnished, as it were, with auriferous compounds, and these have to be decomposed by mercury ere amalgamation can proceed, except we use in conjunction with this metal a substance capable of decomposing such films, or else remove them mechanically, as is at present largely accomplished in the stamper boxes.

With reference to mercury, the results I have as yet been able to get do not point so distinctly to its oxidation by oxygen in presence of water, as those described above do to that of gold. Its mobility at the temperature I have to operate under stands in the way of my observing indications of any superficial change I may have induced upon it in my experiments. Theoretically it would on first thought appear, that if gold or silver does oxidise, as I affirm, under the above circumstances, mercury should also oxidise under them, as it is certainly positive to both these metals in acid generally. It must be considered, however, in connection with this matter, that gold and silver at their fusing-points are in a condition unfavourable to their oxidation, and so mercury (a metal which naturally classes with these), being used in my experiments at a temperature far above its fusing-point, may for this reason be less readily oxidisable under the circumstances stated than either of the above metals in their solid state. It appears to me that we should take into consideration here not only the temperature we are operating under but the different physical conditions of mercury as compared with that of the above metals at this temperature.

The only results I have yet obtained as to the oxidation of mercury or otherwise under these circumstances seems to show that it is so oxidised. Thus I find that electric currents of some strength are generated by it in water containing a little sodic chloride; also in aqueous solution of caustic or carbonated alkali; as the only conceivable effect of the salts named is to conduct the electricity thus generated and so render it detectable, I conclude that the action upon mercury which these currents indicate is not originated by such salts, but by the oxidation of this metal.

Supposing, however, oxidation does occur under the circumstances related above, this may have been induced in part by the oxygen condensed upon the platinum, or carbon which I used in conjunction with the mercury in these experiments, as the negative pole.

If this should on further investigation prove to be so, the question as to the oxidation or otherwise of mercury in presence of oxygen and water alone, practically remains unsettled. So far indeed as these experiments and our general knowledge of the behaviour of this metal show, it appears, that in alkaline solution or in water generally, mercury is probably less readily affected than either gold, silver, or platinum.

The result, however, stated in this paper shows, I think, very clearly that the metals, silver, platinum, and gold, readily oxidise under ordinary circumstances, though only to a small extent. Thus the film of oxide, or rust, as I may properly term it, which is thus formed, never acquires any notable thickness, and so does not manifest its pres-

* Read before the Wellington Philosophical Society, February 12th, 1876.

ence readily to mere physical tests. But this limitation in thickness of such films is not due to want of or weakness of affinity between the underlying metal and oxygen, but rather to the great solidity of these films, and their adherence to the metal, together with their insolubility in the liquid surrounding them, whereby these affinities very soon have their action permanently restrained; contact of the metal with oxygen being thus cut off. Practically there is neither scaling off nor yet any dissolving away of the oxide, or its saline representative, as we have with iron or copper; thus the underlying metal is soon completely protected.

Possibly the knowledge that these metals are chemically acted upon by oxygen may help us to explain the origin of those electric currents which Professor Becquerel obtained by immersing certain "non-oxidisable metals" in pure water. Why should not these currents be in many cases due to the kind of oxidation I have just described, that is to chemical action, rather than, as Professor Becquerel attributes, to "capillary affinity?" Not only this, indeed, but so far as the results I have here given can be taken as correct, it seems certain that a number of cases of so-termed *mechanical* absorption are resolved thereby into cases of *chemical* absorption—chemical affinities being the operant power. This aspect of my subject, however, and certain other matters of interest in connection therewith, I forbear to treat for the present, as I hope to be able soon to take up this subject again.

ON THE ESTIMATION OF MANGANESE IN SPIEGELEISEN AND FERRO-MANGANESE.

By SERGIUS KERN, St. Petersburg.

Spiegeleisen and ferro-manganese are at present much used in the manufacture of steels. A great many analyses of such kind are made in laboratories of iron- and steel-works; very often slags from Siemens-Martin furnaces are also tested for manganese, in order to accurately ascertain at any stage of the operation the proper state of the metallic-bath of the furnace.

The following method, communicated by me to the Russian Chemical Society on the 7th of April, 1877, may be for technical applications strongly recommended:—0·05 grm. of the splegeleisen or ferro-manganese, in powder, is dissolved in 20 to 25 c.c. of aqua regia; the solution is evaporated to dryness, and the resulting mass is re-dissolved in a mixture of 10 c.c. of hydrochloric acid and 15 c.c. of water. The residue, consisting of silica, is filtered off. Iron and manganese are next precipitated, in the form of hydrates, by ammonia: this mixture is concentrated and poured into a platinum crucible, and evaporated to dryness. The dry mass is placed in a weighed tube of hard glass, heat is applied, and at the same time a current of dry hydrogen is passed through the tube; the following reaction takes place:—

$$Fe_2(OH)_6 + Mn_2(OH)_6 + 8H = Fe_2 + 2MnO + 10H_2O.$$

When the mass turns greenish, instead of hydrogen a current of dry chlorine is passed, which transforms the metallic iron into a volatile compound, ferric chloride (Fe_2Cl_6): the chlorine is passed for about 30 to 40 minutes; when the iron is volatilised, a free current of air is passed for about one hour: during this last operation the tube must also be heated by a Bunsen burner. The substance in the tube burns brownish, and mangano-manganic oxide is formed (Mn_3O_4). The tube in a dry state is secondly weighed, and the difference in the weights of the empty tube and the same tube containing Mn_3O_4 will show the quantity of mangano-manganic oxide in the specimen analysed. As this oxide contains 72·05 per cent of manganese, the percentage of manganese in the sample is easily calculated.

Ten analyses were executed by this process on samples in which the manganese was firstly estimated by the well-known Eggertz bromine process. The experiments proved that the difference in the estimation of manganese in the ordinary way and by the above-mentioned process varied between 0·04 and 0·01 per cent. These results show that the process may be safely used in technical and metallurgical applications.

At first sight the new process seems to be very complicated in execution, but practice proved that the work is executed by this method far more quickly and easily than by any other analytical methods.

Some experiments were made in order to simplify the above-described process: they are not yet finished, but altogether it may be found useful to give a short notice of them.

If finely-powdered ferro-manganese is ignited with ammonium-chloride in a high crucible with a metallic cover, the ferric chloride obtained by the reaction,—

$$6NH_4Cl + Fe_2 = Fe_2Cl_6 + 6NH_3 + 3H_2,$$

is volatilised, and condenses in the form of small crystals on the cold metallic surface of the crucible-cover. The cover is gently put off, and the contents of the crucible are dissolved in aqua regia; silica is filtered away; the filtrate is evaporated to dryness in a platinum crucible, which is next strongly heated in the presence of air; the resulting mangano-manganic oxide is weighed, and the percentage is calculated as ordinarily. This process is far more easily executed than the process just mentioned. The analyses which are now in execution will show the accurateness of this analytical method.

Obouchoff Steel Works.

ON THE PROPERTIES OF RESORCIN.

By M. L. CALDERON.

Having at disposal a very large quantity of resorcin, I proposed to determine its physical and chemical properties, commencing with the former.

Commercial resorcin, prepared by means of phenol sulphate, appears ordinarily as a brown humid mass, which possesses a strong odour of phenol, and is often found contaminated with tarry matters, and sometimes also with sulpho-vinic acid and oil of wine. The best process of purification consists in treating the matter with water and a small quantity of lye of soda. A quantity of hydrochloric acid is added insufficient for complete neutralisation; it is agitated with ether, which deposits it in the form of large crystals, weighing sometimes several grms.

Although the form of these crystals has been already studied by M. Groth, I have thought it useful to make it the subject of a new examination. They belong to the orthorhombic system, and present the combinations:—∞P (110), $P\breve{\infty}$ (101); often also ∞P (110), $\infty P\breve{2}$ (120), $P\bar{\infty}$ (101). I have not fonnd in my sample the hemimorphism pointed out by M. Groth; this may depend on the nature of the solvent and the temperature at which the crystals are formed. The following are my measurements:—

	Calderon. Degrees.	Groth. Degrees.	Calculated. Degrees.
(101) : (101)	119·70	118·37	—
(101) : (101)	60·19	—	60·53
(110) : (110)	95·15	95·22	—
(110) : (110)	84·10	—	84·45
(120) : (120)	121·57	121·54	122·33
(101) : (120)	75·11	—	75·46
(110) : (120)	161·29	—	161·30
(110) : (101)	68·45	—	70·90

$$a : b : c = 0{\cdot}912326 : 1 : 0{\cdot}587577.$$

The crystals often appear elongated along the axis a, and sometimes having all the appearance of perfect octahedra.

Resorcin melts at 118°, a melting-point higher by 19°

than that which is commonly admitted. At 90° it gives appreciable vapours and boils at 276·5° under the pressure of 759·7 and between 200° and 210° under a pressure of 7 millimetres. If we melt the substance in a retort and if we heat it up to 220° to 230°, passing through the liquid a current of carbonic acid, or if we heat it to between 140° or 150° to sublime the matter, we may condense in the receiver small crystals as white as snow, extremely fine, and which present under the polarising microscope the phenomenon of lamellar polarisation, but in which I have been unable to recognise the direction of extinction, and whose crystalline system I have been unable to determine. Resorcin heated to 300° is decomposed, leaving a carbonaceous residue.

The vapour density cannot be determined by the common process. Nevertheless, by employing a method applied ten years ago by Berthelot for the determination of the density of the vapour of copahuvin, I have succeeded in obtaining the following results:—

	T.	H.
First experiment	3·918	240° 0·018 m.
Second „	3·806	250° 0·080 m.
Mean	3·862	
Calculated	3·8078	

The density of the solid matter was determined with the specific gravity bottle under a layer of sulphide of carbon, in which resorcin is quite insoluble; I have found—

	0°.	15°.
Solid crystalline matter ..	1·2728	1·2717

The coefficient of dilatation of the solid matter is 0·00007868 between zero and 15°; its molecular volume is consequently—

At zero	86·43
At 15°	86·51

In order to compare its molecular volume with that of phenol and that of benzol, I have determined by means of the specific gravity bottle, the densities of the liquid compound at the temperatures comprised between its point of fusion and 178°. I have obtained the following results:—

Temperatures.	Spec. Gravs.	Molecular Vols.
118°	1·1923	92·260
130	1·1862	92·730
136	1·1812	93·125
145	1.1738	93·710
150	1·1691	94·090
165	1·1556	95·189
170	1·1503	95·627
178	1·1435	96·196

The densities obtained in this manner decrease regularly and coincide sensibly with the curve of the densities calculated by means of the coefficient of dilatation obtained by means of the two extreme densities, and also by the direct observation of the augmentation of volume. This coefficient of dilatation is equal to 0·0007114 between 118° and 178°. If it were permitted to prolong this table up to zero we should find—

	Sp. Gr. at 0°.	V_m.
Solid resorcin	1·2728	86·43
Liquid resorcin	1·2923	85·13
Difference		1·30

Consequently the molecular volume would experience a dilatation of 1·3 in its passage from the solid to the liquid state. The molecular volume of resorcin, $C_{12}H_6O_4$, at the boiling-point, 276°, would be 103·17, a number almost identical with the molecular volume of phenol, $C_{12}.H_6.O_2$; calculated in the same manner the boiling-point, according to the assumption of H. Kopp, would be 103·6. However, this latter surpasses by 7·6 that of benzol, $C_{12}.H_6$, namely 96·0. The difference of composition, $C_{12}H_6O_4 - C_{12}H_6O_2$ being the same as $C_{12}H_6O_2 - C_{12}H_6$, we see that this difference does not correspond to that of the molecular volumes. The comparison made at one and the same temperature, such as 100°, gives—

	Sp. Gr.	V_m.
Benzol	0·7938	98·26
Phenol	1·0128	92·90
Resorcin	1·2076	91·09

Here, again, phenol and resorcin have volumes very closely approaching, and very different from benzol. Resorcin on dissolving in water produces a sensible decrease of temperature; 100 grms. of water dissolve about (I say about because of the difficulty of determining by evaporation the weight of the dissolved resorcin)—

At 0°	86·4
At 12·5°	147·3
At 30·0°	228·6

—*Comptes Rendus.*

TITRATION OF OXALIC ACID AND OXALATES.

By MM. FERD. JEAN and H. PELLET.

The determination of free oxalic acid or of oxalates may be effected very exactly by the aid of baryta water and a standard solution of sulphuric acid; for this purpose we neutralise with care the solution to be assayed with a dilute solution of soda, and then add baryta water in a slight excess and filter. The filtrate is then mixed with seltz water, raised to a boil, separated by filtration from the carbonate of baryta, and in the clear liquid the alkali is titrated with standard sulphuric acid. 0·0777 grm. of SO_3HO = 0·1 grm. $C_2O_3,3HO$. 10 c.c. of a solution containing 1 per cent of $C_2O_3,3HO$ required 11·8 c.c. of a standard acid, of which 10 c.c. = 0·066 grm. of SO_3HO, that is, 0·0778 of sulphuric acid; we then found 0·10001 grm. of oxalic acid instead of 0·1 grm. In another assay we obtained 0·0999 grm.

In order that this process of titration may give good results we must take care to separate the oxalate of baryta before adding seltz water; for this salt is very sensibly decomposed by carbonic acid, and if we do not take this precaution we shall be led into grave errors. We thought to have been able to apply this process to the titration of borates and tartrates, but the assays which we made with this view never gave good results. With boric acid it is impossible to seize the point of neutralisation, and the borates of baryta are all more or less soluble in an alkaline liquid. The tartrate of baryta is equally soluble in baryta water and in alkalies; there are formed, without doubt, double tartrates.—*Bulletin de la Société Chimique de Paris.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 7, 1877.

Dr. J. H. Gladstone, F.R.S., President, in the Chair.

After the announcement of visitors the minutes of the last ordinary and of the extraordinary general meeting were read and confirmed. The list of presents to the library was then announced, and the certificates of the following candidates were read for the first time: W. H. Martin and C. B. Fox, M.D. The President then gave notice that at the next meeting of the Society a ballot for the election of candidates would take place. The following papers were read:—

"*On the Gases Enclosed in Lignite Coal and Mineral Resin, from Bovey Heathfield, Devonshire*," by J. W. Thomas. Four samples were examined. No. 1 Lignite consisted of the leaves and stems of plants in a closely compressed condition, and is known locally as "leafy coal." No. 2 Lignite—dense, compact, of a distinctly woody character and dark brown. No. 3 Lignite was very dense, but earthy and wet in appearance, the cleavages being much encrusted with hydrated oxide of iron; in colour it was nearly black. No. 4. Mineral Resin Retinasphaltum—soft, brown, powdery, lighter than water.

No. 1. Leafy coal from Bovey Heathfield.—100 grms., after heating to 50° for twelve days, gave 56·1 c.c. of gas, containing—CO_2, 87·25; O, 0·24; CO, 3·59; OH_2, 8·92 per cent. After heating to 50° 100 grms. were heated to 100° for eighteen days, and yielded—59·9 c.c. of gas; CO_2, 89·53; C_nH_{2n} gases, 0·33; CO, 5·11; N, 5·03 per cent. On raising the temperature to 150° decomposition set in, and the pellets of mercury in the Sprengel became blackened by the formation of sulphide of mercury. The gas given off had at first an aromatic odour, but afterwards became exceedingly disagreeable from the presence of organo-sulphur bodies, mercaptan, sulphide of allyl, &c. At 200° more than 18 c.c. of gas were collected, the last portions of which contained CO_2, 82·06; H_2, 2·82; CO, 14·00; C_2H_4, 0·49; C_3H_6, 0·48: N, 0·27 per cent. Above 250° it was impossible to collect any gas, the action of the sulphur compounds on the mercury being so energetic as to block the Sprengel.

No. 2 Lignite—100 grms, at 50° evolved 48·5 c.c. of gas, consisting of—CO_2, 96·23; O, 0·11; CO, 2·42; C_nH_{2n} gases, a trace; nitrogen, 1·24 (the first portion of gas which came off contained 16·23 per cent N). At 100° sulphur sublimed in small yellow crystals; the lignite began to decompose at 185°. At 200° the gas consisted of CO_2, 86.30; CO, 7·41; C_nH_{2n} gas, 2·08; marsh gases, 3·34; hydride of propyl, 0·53; nitrogen, 0·34 per cent.

No. 3 Lignite began to decompose at 180°; the gas evolved at 200° consisted of SH_2, 0·41; CO_2, 91·68; C_nH_{2n}, 0·41; CO, 7·12; H, traces; N, 0·38 per cent.

No. 4. Mineral resin from Bovey Heathfield.—At 50° a very small quantity of gas was given off. At 100°, 21·4 c.c. of gas from 100 grms. came over; CO_2, 88·24; O, 0·23; C_nH_{2n}, 0·47; CO, 7·90; N, 3·16 per cent. At 110° to 120° it began to melt and decompose, the sulphur compounds coming off so rapidly as to block the pump. When the temperature was raised to 160°, about 180 c.c. came over, consisting of SH_2, 0·41; CO_2, 78·88; C_nH_{2n} gases 2·67; CO, 7·82; marsh gas 8·05; hydride of propyl, 1·86; nitrogen, 0·31. When compared with the coals of the carboniferous period, it is seen that, as far as the occluded gas is concerned, these lignites resemble most cannel coal, but contain C_nH_{2n} gases, and only matters of the aromatic series instead of gases and compounds of the paraffin series. The lignites are far less stable *in vacuo*, decomposing below 200°, whilst the true coals usually resist a temperature of 300°. The existence in Nos. 1 and 3 of organo-sulphur compounds in the presence of hydrated oxide of iron suggests that the iron pyrites of true coal may have derived their sulphur from that existing in organic combination in the plants from which coal is produced, and not from the reduction of sulphates. The author concluded by pointing out the extremely hygroscopic nature of the Bovey lignites. Mr. Thomas also exhibited two mechanical appliances driven by water or steam for shaking a beaker containing a precipitate so as to promote its settling or for hastening the solution of a substance. He mentioned that with the aid of the apparatus the magnesia precipitate came down from a dilute solution in fifteen to twenty minutes.

After the thanks of the meeting had been given to the author,

The President called on Dr. Frankland to read a paper on "*Apparatus for Gas Analysis*." After giving a short description of the original apparatus introduced by himself and the late Mr. Ward, the author proceeded to point out the various modifications the apparatus had met with at the hands of Mr. Duppa and Professor McLeod. Notwithstanding all improvements there were still some disadvantages connected with the apparatus. In the first place the bottom of the water cylinder was closed by an india-rubber cork, through which the two tubes passed; this cork after a time was liable to stick, and so on removal a risk of breakage was incurred; moreover, it was not rigid, so that when the measuring tube was filled with mercury the weight depressed the india-rubber cork to a slight extent. This defect the author proposes to remedy by substituting a cast-iron plate through which the glass tubes pass water-tight by means of suitable collars, and are clamped by a strong wooden clamp screwed to the cast-iron bottom; a stopcock is inserted into the cast-iron base for the introduction of water instead of passing it down a glass tube. Another defect of the old apparatus was the use of steel caps to unite the laboratory tube with the measuring tube; they are liable to rust, are expensive, form a rigid joint, are always liable to break away from the cement, and, unless very carefully ground, are difficult to make absolutely tight. The author therefore proposes to do away with the steel caps by the following contrivance:—The upper end of the measuring tube terminates in a small cup like a small funnel with a very acute angle. The tube from the laboratory tube is bent twice at right angles, and then drawn out at its end so as to fit into the neck of the above cup (without grinding). It is then covered with a piece of thin sheet unvulcanised india-rubber, the edges of which are cut cut off, warmed, and joined so that a conical stopper of india-rubber is formed; this, when moistened and pressed down into the cup by an india-rubber band and covered with mercury, forms a perfectly air-tight joint, which is nevertheless flexible.

Mr. Warington said the joint had been most severely tried, not only with regard to its tightness, but as regards the possibility of any air space being left between the capillary tube and the cup, but no perceptible error could be detected.

Dr. Frankland said there was another point which he had forgotten to mention, the rack and pinion of Regnault's apparatus was replaced by a long screw, the shelf for the mercury trough sliding on a V shaped guide, and having a nut to fit the screw. In answer to Dr. Wright, who asked if the india-rubber cone was greased or not to secure the tightness of the joint, Dr. Frankland said that the joint was only moistened with water.

Dr. Russell bore testimony to the necessity of wetting india-rubber and glass joints to secure their tightness. With regard to the improvements brought forward by Dr. Frankland, he would say that only those who had worked with the old apparatus could properly appreciate them.

Mr. Greenaway pointed out the great ease with which the laboratory tube could be cleared by reagents now that the steel caps had been god rid of.

Dr. Wright then read a paper on "*Narcotin, Cotarnin, and Hydrocotarnin*," Part V. A large number of experiments made with a view of breaking up cotarnin into simple bodies, and so to elucidate its structure, were as fruitless as were attempts made to synthesise narcotin from mixtures of hydrocotarnin and opianic acid. By acting on hydrocotarnin hydrobromide with bromine, the following actions take place:—

1. $C_{12}H_{13}NO_3, HBr + Br_2 = HBr + \underbrace{C_{12}H_{12}BrNO_3, HBr}_{\text{Bromhyd. cotarnin hydrobromide.}}$

2. $C_{12}H_{14}BrNO_3, HBr + Br_2 = 2HBr + \underbrace{C_{12}H_{12}BrNO_3, HBr}_{\text{Bromocotarnin hydrobromide.}}$

3. $C_{12}H_{12}BrNO_3, HBr + Br_2 = \underbrace{C_{12}H_{12}Br_3NO_3, HBr}_{\text{Tribromhydrocotarnin hydrobromide.}}$

The formation of the first two bodies is preceded by the production of the unstable addition products:—

$$C_{12}H_{15}Br_2NO_3HBr \text{ and } C_{12},$$

and $C_{12}H_{14}Br_3NO_3HBr$ respectively; the third addition product, tribromhydrocotarnin hydrobromide, is a well defined crystalline stable substance. Bromhydrocotarnin and bromocotarnin resemble in general properties hydrocotarnin and cotarnin respectively. The first crystallises anhydrous and melts at 76°. The second is—

$$C_{12}H_{12}BrNO_3,H_2O,$$

and loses water at 100° with decomposition; their hydrobromides crystallise well, that of the first being sparingly soluble in H_2O and anhydrous, while that of the second is easily soluble, and contains $C_{12}H_{12}BrNO_3HBr,H_2O$. When heated to about 200° bromocotarnin hydrobromide fuses, gives off HBr and combustible vapours (apparently CH_3Br), and forms a small quantity of the hydrobromide of a new base termed "tarconin" (anagram on cotarnin and narcotin) $C_{11}H_9NO_3$, and a large amount of an indigo-blue substance, the hydrobromide of a base $C_{20}H_{14}N_2O_6$; this base and its salts are all but insoluble in water, ether, alcohol, benzene, CS_2, petroleum, &c.; boiling aniline and glacial acetic acid dissolve a minute quantity, forming a deep blue fluid; strong H_2SO_4 dissolves it, forming a sulphate $(C_{20}H_{14}N_2O_6)2H_2SO_4$. The solution has a tint rivalling magenta in beauty and intense colouring power. Tribromhydrocotarnin hydrobromide fuses at 200°, and decomposes in accordance with the reaction—

$$C_{12}H_{12}Br_3NO_3,HBr = HBr + CH_3Br + C_{11}H_8BrNO_3,HBr,$$

forming bromotarconin hydrobromide. Bromotarconin forms fine scarlet crystals, $C_{12}H_8BrNO_32H_2O$, which become crimson when dried at 100°. The crimson anhydrous mass, when dissolved in hot absolute alcohol perfectly free from water, separates on cooling in crimson crystals, but if the least trace of moisture be present, the scarlet hydrated crystals appear. The salts are pale yellow, well crystallised and sparingly soluble in cold water. The hydrochloride and hydrobromide contain $2H_2O$. Cotarnin hydrobromide is very soluble—

$$C_{12}H_{13}NO_3HBr_2H_2O;$$

with bromine it forms the addition compound dibromhydrocotarnin hydromide, $C_{12}H_{13}Br_2NO_3HBr$, which, by further action of Br produces tribromhydrocotarnin hydrobromide, identical with that from hydrocotarnin. By the action of water dibromhydrocotarnin hydrobromide splits up into HBr and bromocotarnin hydrobromide. By the action of zinc and hydrochloric acid bromocotarnin takes up H_2 and forms bromhydrocotarnin identical with that obtained by brominating hydrocotarnin. By acting on opianic acid with a large excess of HI almost the theoretical yield of CH_3I is obtained for the reaction—

$$C_{10}H_{10}O_5 + 2HI = 2CH_3I + C_8H_6O_5$$

(noropianic acid). The noropianic acid thus produced crystallises with $2H_2O$, and is not identical with the body recently described by Tiemann as isonoropianic acid.

The next paper was on "*Otto of Limes*," by C. H. Piesse and Dr. Wright. The otto from the rind of the fruit of the *Citrus limetta* had a sp. gr. of 0·90516 at 15·5° C. When distilled, about two-thirds passed over below 186°. After purification by fractional distillation and finally over sodium this yielded a terpene body boiling at 176°. On treating with bromine an unstable dibromide was formed, unlike the dibromide of the hydrocarbon from orange peel (hesperidene). This yielded but little cymene by simple heating, the greater portion being transformed into resinous non-volatile bodies. The cymene thus produced boiled at 176°, and yielded terephthalic and acetic acids by oxidation with chromic acid; hence it would seem that the terpene of the lime is not identical with that of the orange, nothwithstanding the nearness of their boiling-points, but that it is more like the terpene of the lemon (boils about 173°), which, as Openheim has shown, yields a dibromide from which but small quantities of cymene are formed by simple heating. The residue not volatile at 186° was further heated, and gave a few drops of distillate between 186° and 250°. The residue in the retort was a semi-solid resin. On standing two or three months a quantity of crystals formed in this soft mass. These were extracted by the pump filter, well washed with the terpene and with alcohol, and crystallised successively from strong and dilute alcohol. They formed white micaceous plates, scentless, neutral, not volatile without charring, giving numbers agreeing with the formula $C_{24}H_{28}O_5$, melting at 162°, not forming protocatechuic acid on fusing with potash, and therefore not identical or even allied to hesperidin.

Mr. Grosjean pointed out that in Sicily the otto was collected by powerfully squeezing the rind of the lime against a clean sponge. He objected to the formation of new names for chemical substances by the anagrammatic method.

The Secretary, Mr. Perkin, then read a paper by Mr. C. T. Cross on "*Primary Normal Heptyl Alcohol and some of its Derivatives.*" Pure œnanthol was prepared by a rapid dry distillation of castor oil and fractional distillation. Its sp. gr. was 0·823 at 16° C.; at 748·6 m.m. it boiled at 152°. Heptyl alcohol was prepared by acting on 15 grms. of œnanthol dissolved in 150 grms. of 65 per cent acetic acid with 10 grms. of sodium in 1000 grms. of mercury for ten days; the alcohol was drawn off, washed, &c., and purified by fractional distillation. From 300 grms. of impure aldehyd 120 grms. of pure alcohol, boiling 170° to 180°, were obtained. Some of the alcohol was specially purified by rectification over metallic sodium. It is colourless, has an agreeable pear-like odour; sp. gr. at 0° 0·833, at 16° 0·830, at 27° 0·824, at 764·1 m.m. it boiled at 175·5°. The following substances were also prepared:—

	Sp. Gr. at 16°.			
Heptyl chloride ..	0·881,	boils	754·0 m.m. at	159·200°
,, bromide ..	1·133,	,,	750·6 ,,	178·500
,, iodide ..	1·346,	,,	754·8 ,,	201·000
,, acetate ..	0·874,	,,	758·5 ,,	191·500
,, œnanthylate	0·870,	,,	760·0 ,,	270·272
,, ethylether ..	0·790,	,,	748·3 ,,	165·000

In conclusion the author draws attention to the coincidence of the boiling-points of the above compounds with those calculated by Schorlemmer, viz., chloride 158, bromide 179, iodide 202, acetate 191·5.

A short note was then read by the Secretary, from Messrs. Dale and Schorlemmer, "*On the Transformation of Aurin into Rosanilin.*" Since their last communication to the Society (May 24) on this subject the authors have compared the spectra of the hydrochlorides of their base and of rosanilin, and find them quite identical. They have transformed their base into Hofmann's violet, aniline-blue, and aniline-green, obtaining at the same time with the latter the violet. If aurin be heated with alcoholic ammonia for several days to 150° the rosanilin first formed is converted into leucanilin. A similar action does not take place in the formation of rosanilin from aurin, because rosanilin is readily formed by heating aurin with aqueous ammonia to 120° for twenty hours. If the temperature be raised to 180° to 200° other colourless bodies are formed.

The Society then adjourned to June 21, when the following papers will be read:—1. "On Diamyl," by H. Grimshaw; 2. "On Dinaphthyls," by Watson Smith; 3. "On certain Relations between the Oxalates and Carbonates of the Alkalies and Alkaline Earths," by Watson Smith; 4. "Note on Thallious Platino-cyanide," by R. J. Friswell and A. J. Greenaway; 5. "On Crystallised Barium Silicate," by E. W. Prevost; 6. "Note on Anethol and its Homologues," by W. H. Perkin.

PHYSICAL SOCIETY.

June 9th, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidates were elected members of the Society:—Mr. W. H. Northcott and Mr. L. J. Whalley.

Mr. S. P. THOMPSON read a paper "*On Interference Fringes within the Nicol Prism.*" After referring to the original paper by the inventor in 1828, in which this phenomenon was referred to, he gave a general description of it prior to explaining the cause. If the field of a Nicol be explored by the eye it will be seen to be bordered on one side by a margin of violet-blue light, and on the other, when the light passes obliquely through the prism, by an orange band within which lie a series of coloured fringes; these latter are very clearly seen with monochromatic light when a second set within the blue band also appears. The author showed that these two sets are due to interference taking place within the film of balsam at the critical angle of total reflexion for ordinary and extraordinary rays respectively; they are therefore analogous to the interference bands in a thin film placed beneath a prism of a more highly refracting substance, and occurring just within the limit of total internal reflexion, as first observed by Sir W. Herschel.

At the conclusion of the scientific business of the Society, a special general meeting was held.

ERRATUM.—On page 207, column 2, line 7 from bottom, *for* "more" *read* "less."

NOTICES OF BOOKS.

Qualitative Chemical Analysis. By Professors S. H. DOUGLAS and A. B. PRESCOTT. Second Edition, pp. 254. New York: D. van Nostrand. London: Trübner. 1876.

THIS book is in reality, as its second title affirms, a guide in the practical study of chemistry and in the work of analysis. It is not a mere body of directions, to be blindly followed by the student without his having learnt the reason why. If this book be faithfully studied, the habits of "automatic operation" and "superficial observation" —too often the only acquirements learnt in a laboratory— will be accompanied by a sound knowledge of the *principles* on which the plans of qualitative analysis are based. Indeed, if we had before us for review nothing but one more mere manual of analysis, distinguished from the ever-increasing crowd of such manuals to which the attention of teachers and learners is being continually called, by no distinctive superiority, we doubt whether our readers would have thanked us for noticing the book. But the volume before us shows so many marks of ability in its conception, and care in its execution, that it is a real pleasure to speak decisively in its favour.

In criticing a volume on chemical analysis, the minuter details of the treatment adopted would be out of place. But we may give our readers a summary of the contents of the book, and we may also convey some notion of the style in which the subject is handled in a very few lines. After a few preliminary remarks, very sound and intelligible, on the study of chemical analysis, we reach the two chief chapters of the book, relating to the reactions of the metals and acids, respectively. Here the rarer metals and non-metals are introduced, but the rarer organic acids are excluded as not admitting of adequate discussion in a manual for student's use. Indeed, if we include such organic acids as succinic and salicylic in a handbook of ordinary qualitative analyses, such organic bases as methylamine and quinine can scarcely be omitted. Nearly two hundred pages are thus occupied with what may be called the *comparative* chemistry of the metals and bases, of the non-metals and acids. There is no shirking of explanations. Reactions are duly displayed, while a running commentary explains at once why certain properties and changes are utilised in the processes of separation, and also how this is done. That the reactions are chronicled with adequate fulness may be gathered from a single example which we take, haphazard, from the account of iron compounds, which occupies more than five pages (47 to 52):—

"Iron dissolves, in hydrochloric acid and in dilute sulphuric acid, to ferrous salts, with liberation of hydrogen (*a*); in moderately dilute nitric acid, with heat, to ferric nitrate, liberating chiefly nitric oxide (*b*); in cold dilute nitric acid, forming ferrous nitrate with production of ammonium nitrate (*c*), of nitrous oxide (*d*), or of hydrogen (*e*):—

a. $Fe + H_2SO_4 = FeSO_4 + 2H$
b. $2Fe + 8HNO_3 = Fe_2(NO_3)_6 + 2NO + 4H_2O$
c. $4Fe + 10HNO_3 = 4Fe(NO_3)_2 + NH_4NO_3 + 3H_2O$
d. $4Fe + 10HNO_3 = 4Fe(NO_3)_2 + N_2O + 5H_2O$
e. $Fe + 2HNO_3 = Fe(NO_3)_2 + 2H$."

After the foregoing reactions and plans of separation we find a concise account of the "Preliminary Examination," including blowpipe analysis; then follows the systematic analysis of solutions, and a full account of the solubilities of salts. The two pages (245-6) devoted to Reagents do not suffice for a useful discussion of this subject.

CORRESPONDENCE.

DE HAËN'S PROCESS.

To the Editor of the Chemical News.

SIR,—Although your journal has brought some weeks ago an answer to an inquiry on the above process, I trust you will allow me to say a few words on the subject, which, in my opinion, deserves to be widely known and introduced. Several years ago De Haën's process for treating water so as to prevent the formation of incrustations in boilers was brought under my notice by Messrs. Domeier and Co., of 3, Botolph Lane, who represent Mr. De Haën in this country, and who, I make no doubt, will gladly answer any inquiry.

For more than four years the process has been largely used in Germany, not only in a great many factories, but also at several large railway stations, where the engine-boilers are fed, and once introduced it has invariably given entire satisfaction. Professors Heeren, Karmarsch, and Ruhlmann have practically tested the modes of purification and its effects, and strongly recommend it.

I think Mr. Payne, in his letter, is not quite correct in saying there is nothing new in the plan, and as he has made some important additions I, for one, regret he has not placed these additions before the readers of your journal.

Mr. De Haën does not claim any particular merit for a new invention. He frankly states that one of his objects in view is a new application of barium chloride, and the extremely large quantities of the salt sold for the purpose prove his success; he also points out the importance of the purity of the salt, and as its manufacture forms one of his specialities he is ready to furnish practical information for its new application. The removal and conversion of the lime salts which form the incrustation by the combination of lime and barium chloride appears to be simple and

perfect; and I cannot agree with Mr. Payne as to the difficulty arising from the character of the men employed as stokers.

The operation does not require any particular skill; the necessary quantity of barium chloride is readily determined by a simple test, and if this should be inconvenient a few ounces of the water may be sent either to Messrs. Domeier and Co. or myself, who will give the desired information.

The additional trouble is very trifling, and will, I believe, disappear if compared with the serious annoyance, waste of fuel, and loss of time consequent upon the periodical removal of the incrustation and the damage done to the boilers.—I am, &c.,

FREDERICK VERSMANN, Ph.D.

35, Whitecross Place, Wilson Street, Finsbury.
London, E.C., June 6, 1877.

DE HAEN'S PROCESS.

To the Editor of the Chemical News.

SIR,—I am obliged by the kind letter of Mr. Alfred Payne, F.C.S., replying to my inquiry in your issue of May 11, and trust he will accept my thanks.

I have lately read with much pleasure the able paper of Mr. F. G. Rowan "On Boiler Incrustation and Corrosion," read before Section G, British Association, at the recent meeting in Glasgow in September, 1876. The facts and results of observations therein recorded are most valuable and interesting and in every way practical. The following paragraph on page 11 of his pamphlet, which reads as under, however, drew my attention:—

"Two other methods of prevention have also been devised, and seem to be founded upon the fact which, Professor Mills informs me, was first observed by J. Y. Buchanan (*Proc. Royal Soc. of London*, 1873-4, vol. xxii., pp. 192 and 483), that barium chloride decomposes sulphates and liberates the carbonic acid in water. One of these, called 'De Haën's process,' which consists in the use of barium chloride and milk of lime, is now extensively used in Austria and in Krupp's Works in Prussia."

From the preceding extract it would seem as though the De Haën's process had the claim of priority in the use of barium chloride as a preventive against boiler incrustations, and the above paragraph in Mr. Rowan's pamphlet tends to give one rather the impression that the use of the salt for this purpose was not known or practised until very recently. It should be stated, however, that the application of this reagent has been known for many years past. I am not aware how many parties have used this reagent for the object described above; but it is not improbable that others besides myself may at various times have done so.

I successfully tried it at the Wortley Ironworks and Wortley Silkstone Colliery for this object some nine years ago during the year 1868. The cost of the barium salt then as compared with soda-ash being, however, an obstacle to its continued use, as from the bad nature of the water, so much was required, and soda-ash appeared to answer the purpose of a preventive equally well, if not in some respects better, and was found to be cheaper.

Being much inconvenienced for want of a good supply of pure water for boilers at the Wortley Silkstone Colliery, we had chiefly to depend for supplies on the water pumped from the mine, which was, in fact, a mineral water most unfit in every way for this purpose; but which, except in very wet weather, we were compelled to use for the simple reason that none other could be got.

The following determinations of the sulphates made at various times show the unsatisfactory character of this water for boiler purposes. It has also a strong acid reaction with litmus.

Determinations of Sulphates in Water from Wortley Silkstone Colliery; Results Calculated as (Sulphuric Anhydride) SO_3.

Date.	Results in Grains per Gallon. Dry Seasons.	Rainy Seasons.
June 20, 1865	—	27·00
October 12, 1867 ..	—	45·63
November, 1868 ..	—	67·91
March 3, 1875	110·60	—
,, 5, 1875	101·63	—
,, 10, 1875	96·62	—
February 1, 1876 ..	103·55	—
,, 15, 1876 ..	—	68·33
,, 26, 1876 ..	—	78·55
,, 2, 1876 ..	—	76·29
March 6, 1876		81·10
,, 10, 1876	—	88·38
July 26, 1876	134·10	—
,, 27, 1876	137·40	—
	6) 692·46	8) 534·09
Mean average	115·41	66·76

The sulphates were chiefly those of calcium, magnesium, and iron, and all the samples had an acid reaction with blue litmus, those collected during *dry seasons* being *strongly* acid.

From the above series of determinations it will be seen that the character of the water becomes worse as time goes on. The incrustation deposited from this water in the boilers gives the following composition, from which it will be seen that the chief ingredient is calcium sulphate.

Moisture	6·85 per cent.
Combined water, organic matter, &c.	5·80 ,,
Siliceous matter..	1·80 ,,
Peroxide iron and alumina	6·10 ,,
Phosphoric acid, 0·76	
Sulphate of lime	78·55 ,,
Magnesia	0·65 ,,
	99·75

The interiors of the boilers had thick hard crusts continually deposited on them, which could only be hammered off with difficulty, and the boilers had to be very frequently "blown off" with a view to getting rid of as much scale and sediment as possible. As may be presumed the cost of repairing these boilers has always been considerable, and in order to obviate as much as possible the evils arising from the use of this bad water, various artificial remedies have been tried, as for instance, chloride of ammonium process, carbonate of ammonia, soda-ash, &c. Seeing that the chief obnoxious constituent to be got rid of was calcium sulphate, and not improbably some illtle sulphuric acid free, it occurred to me that the most effectual means of doing this would be to commence using barium chloride, which was accordingly done and with very good success. As before stated the chief reason for its discontinuance being the expense of the barium salt used as compared with soda-ash. The method of employing the barium chloride was as follows:—

The feed water was first run into a large tank or dam made near the boiler house; the dissolved barium chloride was then added in quantity about sufficient to precipitate the sulphates; the heavy white precipitate of barium sulphate formed, then allowed to subside to the bottom of the tank, which it quickly did owing to its great weight, and the clear water then run off into a reserve tank, for use in the boilers, which, during the continuance of this process, remained tolerably free from deposit or incrustation of any kind; but if through any carelessness of the stoker the precipitated barium sulphate was allowed to get into the boiler it quickly adhered to the sides and formed a hard crust difficult to be removed. Therefore, so far as my experience goes, I have always found a con

siderable advantage in using what we may call a precipitating tank, and I believe De Haën claims this use of a precipitating tank as one of the essential principles of his process, but he cannot be said to have priority in this.

The precipitating tank is still continued, although soda-ash instead of barium chloride is now used, as by this means the sediment is got rid of before it enters into the boilers—a matter of importance; and in all cases where bad water is of necessity obliged to be used, it will be found both economical and in every way satisfactory to use tanks for the above purpose.

I take the liberty of writing you mentioning this matter, as from the paragraph in Mr. Rowan's pamphlet an erroneous impression might be produced that barium chloride had not been used as a preventive for boiler incrustation previous to the publication of the interesting and valuable researches of J. Y. Buchanan in *Proceedings of the Royal Society*, vol. xxii., 1873 and 1874.—I am, &c.,

THOS. ANDREWS.

DOCTORS' DIPLOMAS.

To the Editor of the Chemical News.

SIR,—Dr. P. Townsend Austen requests me to publish the proof of my statement that the degrees sold by "Medicus" are of the University of Philadelphia.

Some three years ago one or two letters were published exposing the degrees sold by "Medicus," and it was said even then that the University had lost its Charter. At the end of 1874 I noticed that "Medicus" was still advertising, and curious to know what kind of degrees he had to offer I applied to him for a German Ph.D., though aware that the traffic in these degrees had ceased. He answered that he could get me a Ph.D. and M.A. of the University of Philadelphia, and that on sending him £20 I should receive a handsome diploma in order. At the same time he sent me a printed list of the lectures and lecturers at that university.—I am, &c.,

A. A. R.

London, June 9, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 20, May 14, 1877.

Rotatory Action of Quartz upon the Plane of Polarisation of the Dark Heat-rays.—M. P. Desains.—Not adapted for useful abstraction.

Analysis of an Ancient Wine Preserved in a Glass Vessel Sealed by Fusion.—M. Berthelot.—The liquid is yellowish, and contains a solid matter held in suspension, which does not deposit on long standing. The liquid, however, can be clarified by repeated filtrations. The yellowish brown deposit does not contain resin or other characteristic matter, and results doubtless from the slow alteration of the original colouring matter. The liquid possesses a distinctly vinous odour, distinctly aromatic, and recalling that of wine which has been in contact with fatty matters. The flavour is hot and strong, by reason of the simultaneous presence of alcohol, acids, and a trace of aromatic matter. The analysis shows per litre—Alcohol, 45·0 c.c.; fixed acids (estimated as free tartaric acid), 3·6 grms.; bitartrate of potassa, 0·6 grm.; acetic acid, 1·2 grm.; tartrate of lime in distinct traces; traces of acetic ether; no decided indication of chlorides or sulphates. No colouring matter existed in the liquid, at least not in a proportion sufficient to be modified by alkalies or precipitated by acetate of lead. There were mere traces of sugar, or rather of matter capable of reducing cupro-potassic tartrate.

Origin and Nature of Typhoid Fever.—M. J. Guerin.—This paper is of a purely medical nature.

The Otheoscope, a New Modification of the Radiometer.—Mr. W. Crookes.—The contents of this paper are already known to readers of English scientific journals.

Direct Conversion of Mechanical Work into Electricity.—M. E. Guignet.—The Polytechnic School of Rio Janeiro possesses an electro-motor formed of five fixed electro-magnets, and of a movable drum furnished with six bars of soft iron. The current of ten Bunsen elements being passed along the wire of the electro-magnets the drum revolves quickly. This apparatus has long been employed to show how a current of electricity, whatever its origin, may act as a motive power. The same apparatus may serve for the inverse demonstration. If the two ends of the wire of the electro-magnets are connected with a galvanometer, and if the apparatus is turned by hand, a continuous current is produced.

Note on Chemical Researches carried on at the Polytechnic School of Rio de Janeiro.—M. E. Guignet.—The author is engaged with an investigation of the nickeliferous iron of Santa-Catarina. On treating a large quantity of this mineral with aqua regia a crystalline residue was obtained resembling osmide of iridium, but which is simply phosphide of iron (and nickel?). He is also occupied with a curious substance of a mineral aspect, but of a resinous nature, found deposited within the trunks of *Angelim pedra*, in the province of Minas Geraes. The cinchonas of Theresopolis are also under examination. At the experimental gas works of the school trials are being made with the bituminous schists of Bahia, the coal of Tubarao, and the lignites of Cacapava.

Researches at the School of Mines of Ouro Preto.—M. H. Gorceix.—The author is seeking to explain the formation of the topaz and the euclase and the origin of the diamond.

Certain Monochloric Acids of the Acrylic Series.—M. E. Demarcay.—The author has been studying the monochlorated methyl-crotonic, ethyl-crotonic, isopropyl-crotoaic, and propyl-crotonic-acids.

Salts of the Sesquioxide of Chrome.—M. A. Etard. The only crystalline sulphate of chrome hitherto known is the violet sulphate to which Schrœtter gives the formula $Cr_2(SO_4)_3 15H_2O$. This formula—differing by three molecules of water at least from that of the sulphate of alumina, $Al_2(SO_4)_3 18H_2O$—may seem exceptional if we take into account the analogies and the isomorphism which generally prevail between the salts formed by the sesqui-salts of chrome and alumina. Without denying the possible existence of a salt with $15H_2O$ which may be obtained by other methods, the author has sought for a sulphate with $18H_2O$, which he regards as normal, and finds that it may be easily prepared by allowing the vapours of ether to react upon a solution of 100 parts CrO_3 in 150 parts of sulphuric acid and 225 of water. The chromic sulphate thus obtained is a fine violet salt, permanent in the air, and of a well defined composition. If dried in the open air its composition is $Cr_2(SO_4)_3 18H_2O$. At 100° it loses 30·5 per cent of its weight, and, parting with 12 H_2O, it is converted into the green crystalline sulphate $Cr_2(SO_4)_3 6H_2O$. This latter salt, which is deliquescent, loses its six molecules of water at dull redness, and becomes the anhydrous sulphate, $Cr_2(SO_4)_3$. Hence the violet sulphate may be formulated as—

$$[Cr_2(SO_4)_3 6H_2O]12Ag.$$

From the comparison of these formulæ it would seem that the differences between these two varieties are the result of a super-hydration of the violet salt. Along with chrome alum, regarded in its anhydrous state as $Cr_2(SO_4)_4K_2$, may

be ranked a crystalline and well-defined salt of the formula $Cr_2(SO_4)_6K_6$, or in equivalents $Cr_2O_3 3SO_3 3KO, SO_3$. This salt, which is very stable, represents a molecule of anhydrous sesquichloride of chrome, Cr_2Cl_6, in which the chlorine is replaced by residues of bisulphate of potassa, $Cr_2(SO_4K)_6$. The bisulphate of potassa acting as a true monobasic acid, the author proposes to call the new double salt potassio-sulphate of chrome. It is easily obtained by putting small portions of the anhydrous chloride, Cr_2Cl_6, into melted bisulphate of potash, and heating to redness for a few minutes. A sodio-sulphate of chrome and a potassio-sulphate of iron may be obtained in an analogous manner. In these salts the relations between the acid of the sesqui-sulphate and that of the alkaline salt are the same, exactly as in the series of double salts known as magnesian; $Cr_2(SO_4)_3 3SO_4K_2$, potassio-sulphate; $(MgSO_4)_3 3SO_4K_2$ (triple magnesian sulphate).

Researches on Pseudo-purpurin: a Sequel to Researches on the Colouring Matter of Matter.—M. A. Rosenstiehl.

Les Mondes, Revue Hebdomadaire des Sciences, No. 1, May 3, 1877.

This issue contains no original chemical matter.

MEETINGS FOR THE WEEK.

TUESDAY, 19th.—Zoological, 8.30.
WEDNESDAY, 20th.—Geological, 8.
— Meteorological, 7.
THURSDAY, 21st.—Royal, 8.30.
— Chemical, 8. "On Diamyl," Mr. H. Grimshaw. "On Dinaphthyls," Mr. Watson Smith. "On Certain Reactions between the Oxalates and Carbonates of the Alkalies and Alkaline Earths," Mr. Watson Smith. "Note on Thallious Platino-cyanide," Messrs. R. J. Friswell and A. J. Greenaway. "On Crystallised Barium Silicate," Mr. E. W. Prevost. "Note on Anethol and its Homologues," Mr. W. H. Perkin.
— Royal Society Club, 6.30. (Anniversary.)
— Philosophical Club, 6.30.
FRIDAY, 22nd.—Quekett Club, 8.
SATURDAY, 23rd.—Physical, 3.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 22, Albemarle Street, W.—The NEXT ANNUAL GENERAL MEETING will be held at PLYMOUTH, commencing on WEDNESDAY, August 15.

President-Elect.

Prof. ALLEN THOMSON, M.D., LL.D., F.R.S., F.R.S.E.

NOTICE to CONTRIBUTORS of MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several Communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 1, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section ....." If it should be inconvenient to the Author that his Paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G. GRIFFITH, M.A.,
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THE CHEMICAL NEWS.

Vol. XXXV. No. 917.

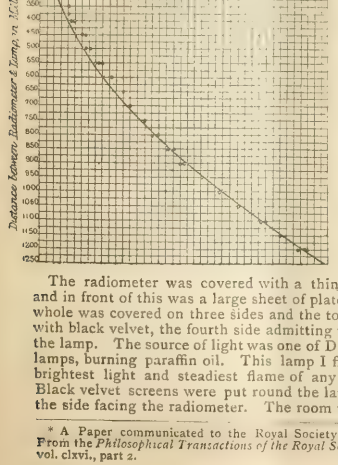
ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 245.)

148. I HAVE proposed for this instrument the name of the *Radiometer*, as it serves to measure the amount of radiation falling upon it by the velocity with which it revolves. It may also be called the *Light-Mill*. The rapidity of revolution is directly proportional to the intensity of the incident rays. Several radiometers, of various constructions, were exhibited at the Soirée of the Royal Society on April 7th, 1875. The following experiments have been tried with radiometers of different kinds and very varying sensitiveness. I could easily have obtained better curves and closer accordance with theory by repeating some of the observations with more recent instruments; but the results already obtained are sufficient to prove the laws, and I could do no more than this were I to repeat the experiments.

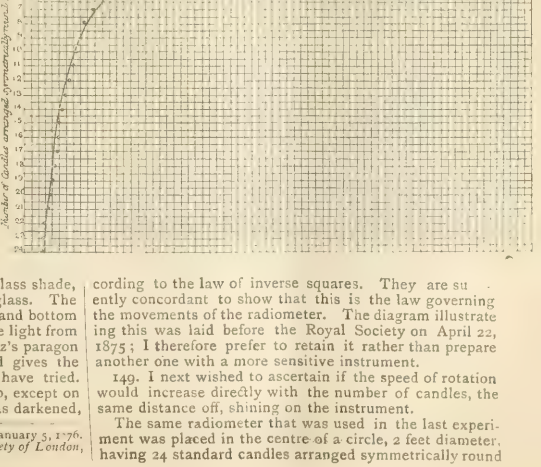
As soon as the radiometer was seen to revolve it was apparent that the stronger the light the more rapid was the movement. The second instrument which was made, the vacuum being very imperfect, the moving parts (straw arms and pith surfaces) heavy, and the instrument accordingly comparatively insensitive, was mounted for the purpose of testing its action at different distances.



The radiometer was covered with a thin glass shade, and in front of this was a large sheet of plate glass. The whole was covered on three sides and the top and bottom with black velvet, the fourth side admitting the light from the lamp. The source of light was one of Dietz's paragon lamps, burning paraffin oil. This lamp I find gives the brightest light and steadiest flame of any I have tried. Black velvet screens were put round the lamp, except on the side facing the radiometer. The room was darkened, and the temperature was kept uniform. The radiometer was kept fixed, and the lamp was moved backwards and forwards along a graduated scale, the number of seconds required for the radiometer to make one revolution being recorded by a chronograph watch. The following Table gives the results:—

Distances between Radiometer and Centre of Lamp-flame, in Millimetres.	Number of Seconds of Time required for the Revolution of the Radiometer.
150 millims.	6 seconds.
200 ,,	8, 9 ,,
250 ,,	11 ,,
300 ,,	15, 16 ,,
350 ,,	20 ,,
375 ,,	21 ,,
400 ,,	23, 24 ,,
450 ,,	29, 31 ,,
500 ,,	34, 36 ,,
550 ,,	40, 42, 44 ,,
600 ,,	52 ,,
650 ,,	60 ,,
700 ,,	65 ,,
750 ,,	74 ,,
800 ,,	82, 84 ,,
850 ,,	93, 95 ,,
900 ,,	100, 102 ,,
950 ,,	116 ,,
1000 ,,	129 ,,
1050 ,,	140 ,,
1100 ,,	158 ,,
1150 ,,	170 ,,
1200 ,,	184, 188 ,,

The diagram fig. 7 shows the curve formed by these observations. The isolated dots show the experimental observations, and the continuous line gives the theoretical curve. [illegible] to have been followed [illegible]



149. I next wished to ascertain if the speed of rotation would increase directly with the number of candles, the same distance off, shining on the instrument.

The same radiometer that was used in the last experiment was placed in the centre of a circle, 2 feet diameter, having 24 standard candles arranged symmetrically round

cording to the law of inverse squares. They are sufficiently concordant to show that this is the law governing the movements of the radiometer. The diagram illustrating this was laid before the Royal Society on April 22, 1875; I therefore prefer to retain it rather than prepare another one with a more sensitive instrument.

* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

the circumference. All the candles were lighted at first, and the times of revolution taken as they were removed one by one.

Number of Candles Burning 1 foot off.	Number of Seconds required for one Revolution of Radiometer.
	6·4 mean.
24	
23	7 ,,
22	7·5 ,,
21	8·5 ,,
20	9·5 ,,
19	10 ,,
18	11 ,,
17	11·3 ,,
16	12 ,,
15	13 ,,
14	13·3 ,,
13	14·5 ,,
12	16 ,,
11	17 ,,
10	18·5 ,,
9	19·7 ,,
8	21 ,,
7	23·5 ,,
6	28 ,,
5	35·5 ,,
4	44·5 ,,
3	59 ,,
2	92 ,,
1	180 ,,

The diagram shown in fig. 8 gives these observations, with the theoretical curve. Like the last one, this diagram was handed in to the Royal Society on April 22, 1875.

With a recently made instrument I should have been able to obtain better results. A radiometer now before me will revolve once in eight seconds to the light of a candle 1 foot off, whilst 24 candles make it spin with such velocity as to become almost invisible.

150. From the construction of the radiometer it is evident that the position of the light in the horizontal plane is of no consequence, provided the distance is not altered. This was tested during the last-described experiment. When a candle had to be removed, it was found to make no difference from what part of the circle it was taken. The following experiments were tried to further verify this result, the radiometer being a different one from that last used :—

	Seconds.
1 candle, placed 1 foot from centre of radiometer, gave 1 revolution in 78 seconds (78×1=)	78
2 candles, placed 1 foot from centre of radiometer and put close together, gave 1 revolution in 39·5 seconds (39·5×2=)	79
2 candles, placed opposite to each other, gave 1 revolution in 39 seconds (39×2=)	78
3 candles, close together, gave 1 revolution in 26·5 seconds (26·5×3=)	79·5
3 candles, spread round circumference, gave 1 revolution in 26 seconds (26×3=) ..	78
4 candles, close together, gave 1 revolution in 19 seconds (19×4=)	76
5 candles, close together, gave 1 revolution in 16 seconds (16×5=)	80
5 candles, spread round circumference, gave 1 revolution in 15·5 seconds (15·5×5=)	77·5

151. I wished now to ascertain what would be the effect of bringing a radiometer into a uniformly lighted space, so that there should be no difference of action on any side.

A radiometer was covered over the top with a large sheet of paper, and the light from an argand gas-burner was reflected vertically downwards on to the paper. The apparatus was arranged so that, as near as possible, exactly the same amount of light should illuminate the instrument all round. The arms revolved at a uniform speed of one revolution in six seconds, and kept on at this rate as long as the experiment lasted.

A radiometer was taken on to the roof of the house, where there was an almost uninterupted view all round. The sky was of a uniform dull leaden colour, a cold north-east wind was blowing, and, as far as the eye could judge, there was no difference in the amount of light received from any quarter of the sky. The radiometer was covered with a white handkerchief, to still further diffuse the light. In this condition the arms made one revolution in an average of 1·9 second. On shading the light from the south the time of revolution was 2·7 seconds. On shading it from the north the time was one revolution in 2·9 seconds. With the west shaded off it was one in 2·3 seconds; and with the east shaded off, the rate was one in 2·9 seconds.

The same radiometer, exposed near a south-east window in a room in the afternoon of the same dull April day, revolved once in 16 seconds.

[The radiometer shows a striking difference between heat and light, as commonly expressed. Brought into a uniformly *heated* space, the instrument comes to rest as soon as it has acquired the temperature of the space; but brought into a uniformly *lighted* space (151) it continues revolving as long as the light lasts.—Received January 10, 1876.]

(To be continued.)

RESEARCHES ON EMERALDS AND BERYLS.*

PART II.—ON SOME OF THE PROCESSES EMPLOYED IN THE ANALYSIS OF EMERALDS AND BERYLS."

By C. GREVILLE WILLIAMS, F.R.S.

WHILE analysing the beryl "A" from Ireland, frequently mentioned in the first part of this investigation,† so many unexpected phenomena presented themselves to the author that he found it necessary to study carefully all the processes which have been published for the separation of glucina from alumina. On consulting the numerous papers on the subject, it became apparent that a wide difference of opinion existed amongst chemists as to the best method of working. Among the eleven or twelve methods which have been proposed for the purpose, there are three which have been especially employed in the most important researches. These are placed below, and under each heading will be found the names of some of the chemists who have used the process; the first in each case being that of the inventor.

Carbonate of Ammonium.	Hydrate of Potassium.	Chloride of Ammonium.
Vauquelin .. 1798.	Vauquelin .. 1798.	Berzelius 1812.
Klaproth .. 1801.	C. G. Gmelin 1840.	Weeren 1854.
Lewy .. .. 1857.	Awdejew .. 1843.	
Hofmeister 1859.	Damour .. 1843.	
	Ebelmen .. 1848.	

The author's paper is devoted to a study of the first of these, namely, the carbonate of ammonium process.

The following are the principal questions or problems which he has endeavoured to solve :—

1. Is glucina permanently soluble in a solution of carbonate of ammonium?
2. Does glucina confer its solubility on alumina, or does alumina confer its insolubility on glucina?
3. With what amount of accuracy can a mixture of glucina and alumina be separated by means of carbonate of ammonium?
4. How do solutions of glucina and alumina behave with carbonate of barium?

* Abstract of a Paper read before the Royal Society, April 26, 1877.

† *Proc. Royal Soc.*, No. 145, 1873.

I. *Is Glucina Permanently Soluble in a Solution of Carbonate of Ammonium?*

This question is of paramount importance, because if glucina once dissolved in carbonate of ammonium is liable to assume an insoluble condition and separate from the solution, it introduces a complication into the process, the effect of which it is difficult to estimate. Joy* states that "If the solution be kept longer than ten days a precipitate of carbonate of glucina will begin to form, and at the expiration of sixteen days 15 per cent less of the original amount will go (*sic*) into solution." This assertion of Joy's caused the author some perplexity at first, as he had during many years repeatedly dissolved glucina in solution of carbonate of ammonium, but had never observed a deposit to take place *unless he had reason to suspect the presence of alumina*. He therefore resolved to submit pure glucina, and mixtures of that earth with alumina, to repeated quantitative experiments, with the view of deciding the question.

Experiment I.—0·6943 grm. of glucina, which had already been partially purified by solution in carbonate of ammonium, was dissolved in hydrochloric acid; ammonium hydrate was then dropped in until the solution was very nearly neutral, and 138 c.c. of solution of carbonate of ammonium were added.† At first nearly everything was dissolved, but a precipitate soon commenced to form. This is quite characteristic of the presence of alumina. The solution was filtered next day, and the precipitate was collected, washed, dried, and burnt with all the usual precautions. The weight of the alumina was 0·0058 grm., or 0·84 per cent on the glucina taken. The solution was put aside in a well-stoppered bottle, with the intention of filtering it in sixteen days; but as much more than that time passed without a precipitate forming, it was put away carefully for *three years*. At the end of this time the bottle, on being shaken, showed a barely perceptible trace of deposit; nevertheless, it was filtered off with every precaution and was found to weigh 0·0038 grm., or 0·55 per cent, and this was probably partly alumina and partly silicate, arising from a slight decomposition which had taken place of the glass of the bottle.

Experiment II.—0·2140 grm. of the glucina which had remained three years in solution was next experimented on. The earth was dissolved and heated as before with 50 c.c. of carbonate of ammonium solution. In ten minutes after being well agitated all but a few imponderable flocks were dissolved. In fifty minutes they were scarcely visible. Two days after they had totally disappeared. In sixteen days, the period at which Joy says 15 per cent less of the glucina will remain in solution, the liquid was filtered and yielded 0·0023 grm. of precipitate, or 1·07 per cent, a quantity which might partly arise from insufficient washing, partly from a variation from the mean weight in the filter-ash, and also from a trace of alumina.

Experiment III.—0·1603 grm. of glucina known to contain a little alumina was dissolved in hydrochloric acid, neutralised as usual, and treated with 50 c.c. of solution of carbonate of ammonium. The residue of alumina weighed 0·0071. In two days 0·0067 grm. more was obtained. On filtering sixteen days afterwards only 0·0017 grm., or 1·06 per cent, was obtained. In one year after that time the solution was again filtered, the deposit weighed 0·0012 grm., or 0·75 per cent, being only one-third of the weight of the ash of one filter paper.

Experiment IV.—0·3846 grm. of *pure* glucina was treated in the usual manner with 80 c.c. of carbonate of ammonium solution. The whole dissolved perfectly in a few minutes. The solution was kept for three weeks and then filtered. The precipitate weighed 0·0003 grm., or 0·08 per cent, after deducting the filter-ash. These experiments lead the author, therefore, to affirm unhesitatingly that *one decigrm. of pure glucina is permanently soluble in 25 c.c. of a saturated solution of carbonate of ammonium.*

It was necessary, in order to make these experiments complete, to ascertain whether great variations in temperature influenced the solubility of glucina in solution of carbonate of ammonium. That glucina was permanently soluble at about 15° C. there remained no doubt, but there might still be a tendency in glucina to assume an insoluble form at higher temperatures. To determine this question it was essential to use a temperature many degrees higher than that ever reached by the atmosphere. For this purpose 4 decigrms. of pure glucina were dissolved in the usual way in 100 c.c. of solution of carbonate of ammonium. 15 c.c. of this solution were transferred to a glass tube, which was then sealed and heated to 100° for two days. *The solution remained perfectly clear.*

2. *Does Glucina Confer its Solublility on Alumina, or does Alumina Confer its Insolubility on Glucina?*

The following experiment was made to affix a quantitative value to the amount of alumina soluble in carbonate of ammonium when no glucina was present to influence its solubility.

0·5000 grm. of pure alumina was dissolved in hydrochloric acid and precipitated (after neutralisation with carbonate of ammonium) with 100 c.c. of solution of the carbonate. The whole was thrown on a filter at once. The contents of the filter were washed, dried, and ignited. The alumina which had precipitated at once weighed 0·4702 grm. The filtrate, on standing twenty-four hours, had yielded a deposit weighing 0·0281 grm. These numbers, reduced to percentages, are as follows:—

Alumina precipitated at once	94·04
,, coming down afterwards ..	5·62
Loss	0·34
	100·00

It was considered that the question, whether glucina confers its solubility on alumina, would be best answered by treating with carbonate of ammonium a mixture containing a great excess of glucina.

Experiment I.—A mixture was therefore made of 0·2500 grm. of glucina and 0·0250 grm. of alumina. It was dissolved in hydrochloric acid, and the excess of acid was removed by evaporation; 50 c.c. of carbonate of ammonium solution were then added. The precipitate at first formed *entirely re-dissolved* in a few minutes, but the alumina commenced to deposit it about fifteen minutes afterwards. The mixture was allowed to stand for twenty-four hours and was then filtered. The precipitate of alumina containing glucina weighed 0·0323 grm. The glucina recovered from the solution weighed 0·2407 grm.; or, per cent:—

	Composition of Mixture.	Found after One Extraction.
Glucina	90·91	87·53
Alumina	9·09	11·75
	100·00	99·28

The glucina, although in such great excess, had, therefore, under the circumstances indicated, not conferred its solubility on the alumina; but, on the contrary, the alumina had conferred its insolubility on the glucina.

Experiment II.—The alumina obtained in the manner described was re-dissolved, re-precipitated, and again treated with 25 c.c. of carbonate of ammonium solution for twenty-four hours. The glucina had now increased to 0·2432, and the alumina diminished to 0·0298. The composition of the mixture, as found after two extractions, was therefore as follows:—

	Found after Two Extractions.
Glucina	88·44
Alumina..	10·84
	99·28

* *American Journ. of Science*, xxxvi., p. 89.

† The solution of carbonate of ammonium used in these experiments was always of the same strength, *i.e.*, a cold saturated solution, sp. gr. 1·080.

After two extractions the alumina therefore still retained nearly 2 per cent of glucina.

Experiment III.—Although these results seemed conclusive as far as they went, the author resolved to repeat the experiment with a mixture containing a still greater excess of glucina, because it appeared especially important in an inquiry of this kind to know the behaviour towards a solution of carbonate of ammonium, of glucina containing a comparatively small proportion of alumina. For this purpose a mixture was taken of 1 grm. of glucina and 3 centigrms. of alumina; it was dissolved as usual, precipitated in the form of carbonates of the earths, and heated with 100 c.c. of solution of carbonate of ammonium. The earths dissolved entirely at first; but small as the quantity of alumina was, the solution began to get turbid in about ten minutes. The mixture was left in the cold for twenty hours. The residue of alumina containing glucina was then filtered off, treated in the usual manner, and weighed. The glucina recovered from the solution weighed 0·9846 grm.

	Composition of Mixture.	Found after One Extraction.
Glucina	97·09	95·59
Alumina	2·91	4·16
	100·00	99·75

Alumina, therefore, even when mixed with glucina to the small extent of 3 per cent, renders some of the latter insoluble; this, then, is a distinct answer to the question at the head of the section.

3. *With what Amount of Accuracy can a Mixture of Glucina and Alumina be Separated by Means of Carbonate of Ammonium?*

The fact that alumina confers its insolubility on glucina is the cause of the difficulties that have been found in the separation of the two earths. The author's experiments showed that one treatment with carbonate of ammonium is insufficient to dissolve the glucina out from such a mixture. He wishes, however, to guard himself from appearing to express the opinion that it would be impossible, by a modification of the process, to effect the separation at one operation, as he is now engaged in an attempt to solve that problem.

In order to ascertain the number of times that it would be necessary to treat the insoluble residue with carbonate of ammonium, in order to extract all the glucina, the following experiments were made:—

Experiment I.—A mixture was taken of 0·5000 grm. of glucina and the same amount of alumina; after three treatments for forty-eight hours each with carbonate of ammonium the following results were obtained. The residue of alumina weighed 0·5107 grm.

No. of Extractions.	Glucina Obtained.
I.	0·3896
II.	0·0739
III.	0·0203
	0·4838

	Composition of Mixture.	Obtained in Three Treatments.
Glucina	50·00	48·38
Alumina	50·00	51·07
	100·00	99·45

Experiment II.—Upon a similar mixture the following modification of the process was tried. The mixture was dissolved in hydrochloric acid, the excess of acid was neutralised with ammonia, and 200 c.c. of a *warm* solution of ammonium carbonate were added. The solution was stirred briskly for five minutes, and then filtered off rapidly. The precipitate was only washed moderately so as not to dilute the filtrate too much. The filtrate was allowed to stand for twenty-four hours, the deposit was filtered off, added to the first residue, dissolved with it in hydrochloric acid, and again treated twice with 100 c.c. of carbonate of ammonium solution in the cold for twenty-four hours each time. The alumina weighed 0·5201 grm.

No. of Extractions.	Glucina Obtained.
I.	0·4450
II.	0·0163
III.	0·0161
	0·4774

	Composition of Mixture.	Obtained in Three Treatments.
Glucina	50·00	47·74
Alumina	50·00	52·01
	100·00	99·75

Experiment III.—A mixture was then prepared of 0·2640 grm. of glucina and 0·8520 grm. of alumina. It was dissolved in hydrochloric acid, neutralised with carbonate of ammonium, and digested with 95 c.c. of the carbonate of ammonium solution for twenty-four hours; it was stirred occasionally. The solution was then filtered, the residue dissolved in hydrochloric acid, and after neutralising was heated with 100 c.c. of a cold solution of carbonate of ammonium, and allowed to stand twelve hours. The glucina was separated in the usual manner. This mode of proceeding was repeated seven times with the results given in the annexed Table:—

No. of Extractions.	Glucina Obtained. Per cent.
I.	12·75
II.	3·24
III.	0·61
IV.	3·74
V.	1·26
VI.	0·56
VII.	1·13
	23·29

	Composition of Mixture.	Obtained in Seven Treatments.
Glucina	23·66	23·29
Alumina	76·34	–
	100·00	

The alumina was not estimated in this experiment.

The answer, then, to the question at the head of the section is, that results to within half a per cent of the truth can be obtained by means of the carbonate of ammonium process if a sufficient number of extractions be made.

4. *How do Solutions of Glucina and Alumina Behave with Carbonate of Barium?*

To study this subject quantitatively the author made the following experiments:—

Experiment I. (*Precipitation of Alumina in the Cold by Carbonate of Barium.*)—0·8034 grm. of pure alumina was dissolved in hydrochloric acid. The solution was nearly neutralised with carbonate of sodium, and an excess of carbonate of barium, made into a cream with water, was added. After standing twelve hours the precipitate was collected, washed, and dissolved in hydrochloric acid. The solution was then boiled and precipitated with an excess of sulphuric acid. The sulphate of barium was filtered off with the usual precautions, and the filtrate was precipitated by ammonia. The precipitate was thoroughly washed, dried, and ignited; it weighed 0·8005 grm., or 99·64 per cent on the original alumina. Alumina is therefore completely precipitated in the cold by carbonate of barium.

Experiment II. (*Precipitation of Glucina in the Cold by Carbonate of Barium.*)—0·5175 grm. of pure glucina was

dissolved in hydrochoric acid, and treated precisely as the alumina had been in the last experiment. The precipitate weighed 0·1070 grm., or 20·68 per cent on the original glucina. This result, therefore, confirms the observation of Awdejew,* that glucina is only imperfectly precipitated by carbonate of barium in the cold, and, under the circumstances indicated, behaves like the nitrate in Ordway's experiment.†

Experiment III. (*Precipitation of a Mixture of Glucina and Alumina in the Cold by Carbonate of Barium.*)—0·2096 grm. of pure alumina and 0·2055 of pure glucina were dissolved in hydrochloric acid, and treated precisely like the alumina in Experiment I. The precipitate of the mixed earths weighed 0·3874 grm., or 93·33 per cent on the original weight. Alumina, therefore, in this case, as in the experiment with carbonate of ammonium, communicates much of its insolubility to the glucina.

Assuming only the portion precipitated by carbonate of barium to be accounted for in the analysis of a beryl containing 28·89 per cent of the mixed earths, only 26·96 would be obtained, the loss being 6·67 per cent, which, as we have seen, would fall chiefly upon the glucina, if the operation were conducted in the cold. This loss is, however, variable, and appears to depend, to some extent, upon the relative proportions of the two earths.

ON THE DETERMINATION OF COPPER IN "ORE REDUCER" SLAG.

By T. C. CLOUD.
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THE following experiments were undertaken with the view of ascertaining whether the method of decomposing "ore reducer" slag by means of nitro-hydrochloric acid, as usually recommended, is one of general application, and suitable for the determination of copper in the slags produced at these Works.

A sample of "ore reducer" slag was ground down, in an agate mortar, to an impalpable powder—finer, indeed, than is usual in connection with this method. Two grms. were digested with nitro-hydrochloric acid for three days (twenty-four hours) in a covered beaker. At the end of this time the cover was removed, and, after washing it and the sides of the beaker with water, sulphuric acid was added, and the contents of the beaker evaporated until the fumes of this acid commenced to be evolved. When cool, water was added, and the copper determined by plating it out on a weighed platinum cylinder forming the cathode of a two-cell Daniell's battery. When all the copper had been thus deposited from the solution the platinum cylinder was removed, washed successively with boiling water and alcohol, dried at 100° C., and re-weighed. The sample of slag in question, treated as described, gave 0·25 per cent copper. Another portion of the same sample, treated as above described, but with the addition of a small quantity of concentrated sulphuric acid previous to the nitro-hydrochloric acid, gave 0·35 per cent copper. It was evident, from the appearance of the contents of the beaker, that decomposition had proceeded farther than in the first instance, but a large quantity of dark-coloured silicate yet remained. After the copper had been removed from the solution the insoluble residue was dried, and again treated with acid as before for three days. The solution again yielded copper.

The endeavour was next made to decompose the slag by fusion with bisulphate of potash. Two grms. of the slag were fused with a considerable excess of the salt for one hour, and the fused mass, after cooling, treated with water. A dark-coloured residue, apparently of undecomposed silicate, remained. The sample thus treated gave 0·59 per cent of copper.

Finally, the thorough decomposition of the slag was effected by fusing it with 4 parts of the mixed carbonates of potash and soda and one-fourth part of nitrate of potash. The fused mass was treated with dilute sulphuric acid evaporated to a suitable quantity, and the copper determined as above described. The total amount of copper in the slag was thus shown to be 0·64 per cent.

A sample from another slag gave, by treatment with the three acids, 0·55 per cent of copper; by fusion with alkaline carbonates and small quantity of nitrate of potash it gave 0·60 per cent. In no case, so far as my experience goes, is the slag completely decomposed by treatment with acids, even when the action is continued for three days; but it frequently happens that the copper is *nearly* all in that portion which is decomposed, as is instanced in the result obtained from the second sample mentioned above. More frequently, however, the copper is not all obtained in solution. From these results it is evident that the most reliable method for general use is by fusion in the usual manner. With the slag decomposed in this way, and the copper determined in the manner indicated,* the process leaves nothing to be desired, either on the score of accuracy or speed.

Laboratory, "Wallaroo Smelting Works,"
Wallaroo, S. Australia, March 10, 1877.

REPORT

ON THE METHODS EMPLOYED IN THE

ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,

AND ON THE

MODE OF STATING THE RESULTS.†

Section I.

THE DETERMINATION OF POTASSIUM IN COMMERCIAL POTASH SALTS.

THE evidence on this subject obtained previously to the last Meeting (Bristol) of the Association, showed that the method of determining potassium by precipitation, as a platinum salt, was almost universally employed by chemists of large experience in the assay of potash salts. The Committee thought it desirable, therefore, to subject the process to an exhaustive examination, with a view of ascertaining the origin of the discrepancies known to occur between the results of chemists using different modifications of the general method of estimation by platinum.

The process of determining potassium by platinic chloride is well known to depend on the sparing solubility of chloro-platinate of potassium and the easy solubility of the chloro-platinates of the associated metals. The precipitate is crystalline, of a bright yellow colour, and is easily dried. On account of its solubility in aqueous liquids, it is necessary to operate on concentrated solutions and to employ alcohol for washing. When the precipitate is produced suddenly, by addition of platinic chloride to a concentrated solution of potassium chloride, or by rapidly cooling a hot saturated aqueous solution of potassium chloro-platinate, it is obtained in a finely granular or pulverulent form, which presents some difficulty in manipulation, from its tendency to creep over the edge of the filter. When the chloro-platinate is formed by the gradual concentration of a dilute aqueous solution, or by adding chloride of platinum to a dilute solution of chloride of potassium, and then concentrating,

* *Poggendorff's Annalen*, lvi., p. 101.
† *Silliman's American journ.*, xxxi., p. 197.

* The usual colouration test might possibly be employed here if an approximate result is all that is required, but I have not tried it in connection with the fusion process.

† Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

the precipitate assumes the form of dense crystalline scales, the subsequent manipulation of which is very easy.

The following modifications of the general process have been employed by the Committee with the view of testing their comparative accuracy under various conditions likely to occur in practice. The information forming the basis of the experiments was chiefly communicated to the Committee during last year, and to a great extent was incorporated in the Report presented at the Bristol Meeting.

Modification I.—Essentially the process of Professor Fresenius described in his "Manual of Quantitative Analysis," being shortly as follows:—The solution of mixed chlorides of potassium and sodium, freed, if necessary, from calcium, magnesium, and sulphates, was evaporated nearly to dryness with excess of solution of platinic chloride. (In many of the experiments a considerable excess of platinum was employed beyond the quantity required to convert both the alkali metals into chloro-platinates.) The evaporated solution was then treated with alcohol of about 80 per cent, transferred to a small filter, washed with alcohol of 80 per cent, and carefully dried. The bulk of the precipitate was then transferred to a weighed capsule, dried at 100° C., and weighed. The filter with from 1 to 3 milligrammes of adherent precipitate was ignited, the weight of the filter-ash (0·0004 grm.) subtracted, and the residue of $Pt+2KCl$ calculated to $2KCl+PtCl_4$, the amount thus obtained being added to the main quantity.

Modification II.—The above process, with the following precautions, was recommended by Dr. Fresenius in a communication to this Committee:—"To make sure not to keep any chloride of sodium along with the chloride of platinum and potassium, I first extract the chloride of platinum and sodium with spirits of wine of 80°, and then wash the chloride of platinum and potassium with a few c.c. of water, drop by drop; then I evaporate this solution, adding a little chloride of platinum, treat the small precipitate again with spirit of wine, and add the small quantity of chloride of platinum and potassium to the bulk."

Modification III.—The third modification is that of Drs. Frank and Berrand, of Leopoldshall. These chemists employ only about 0·2 grm. of the potassium salt, and manipulate like Fresenius, but they wash the precipitate with alcohol of 98 per cent, which is practically absolute. They dry the precipitate at 110° C.

Modification IV.—The fourth modification is that of Mr. R. R. Tatlock, who thus describes it in his communication to the Committee:—"A portion of the solution, equal to 10 grains of the original sample, is delivered into a small basin, diluted with 400 grains or so of water, and acidified slightly with hydrochloric acid. About 500 grs. of platinic chloride solution (containing at least 25 grs. of platinum) are added, and the fluid evaporated nearly to dryness on a water-bath. A few drops of water are then added to the residue, and the evaporation repeated to expel the excess of hydrochloric acid. About 50 grs. more of the strong platinic solution are mixed with the precipitate, and the whole stirred well and set aside in a cold place for at least an hour, with occasional stirring. The precipitate is then thrown on a very small filter (unweighed), the basin rinsed out with about 10 drops more of the platinum solution, and the precipitate on the filter washed with 10 or 15 drops more. The basin and the filter and contents are then washed with the smallest possible quantity of alcohol of 95 per cent strength, and dried at 100° C. The dried precipitate is transferred as completely as possible to a small capsule, in which it is further dried until it assumes a distinct orange colour, and weighed. The filter, with a trace of adhering precipitate, is ignited on a crucible lid, and the residual metal, with its corresponding chloride of potassium, calculated to potassio-platinic chloride, and the weight added to that of the precipitate."

From the above description it will be seen that the chief points of difference in the processes are as follow:—

Fresenius (Process I.) uses moderately strong alcohol (80 per cent for washing the precipitate, but in his modified process he subsequently uses a few centimetres of water, and recovers any potassium salt thus dissolved.

Frank and Berrand wash with absolute alcohol.

Tatlock washes first with strong solution of platinic chloride, and then with strong alcohol.

In all editions of his "Quantitative Analysis" prior to the 7th English, Fresenius directs the drying of the precipitated chloro-platinate at 100° C. In the last edition drying at 130° C. is recommended. Frank and Berrand use 110° C. Until after the conclusion of the investigations the words "further dried," in Tatlock's method, were understood by the Committee to signify longer drying at 100° C., but it has since been learnt that drying at a somewhat higher temperature was intended.

In all cases in which the temperature used for drying the precipitate is not expressly stated, the Committee employed 100° C. The experiments instituted to ascertain the influence the temperature used in drying had on the weight of the precipitate showed a loss of 0·067 per cent, by subjecting the precipitate thoroughly dried at 100° C. to a temperature of 140° C. for one hour. This loss represents only 0·02 for 100 parts of potassium chloride.

In order to obtain a satisfactory basis of investigation it was necessary, in the first place, to obtain perfectly pure potassium salts, and as a necessary condition of the requisite purity was complete freedom from sodium compounds, their preparation was found less easy than might be expected.*

In the first place an attempt was made to obtain pure potassium chloride by repeatedly evaporating pure nitre with hydrochloric acid. The result showed that the reaction took place with far less facility than was expected, and the process was abandoned.

Chloride of potassium was next obtained by dissolving the purest commercial acid potassium carbonate in hydrochloric acid, filtering and repeatedly crystallising the product. Ignition of the crystals on platinum wire in the Bunsen flame showed the presence of sodium in abundance, and two determination of the real chloride of potassium as platinum salt gave 98·93 and 98·85 per cent respectively. A highly satisfactory product was at length obtained by the following process:—Cream of tartar was dissolved in hot water, the liquid filtered, and the acid-tartrate of potassium obtained by cooling the solution. The product was re-crystallised, and then tested for sulphates and sodium, neither of which was found. The dried crystals were ignited, the mass dissolved in water, the liquid filtered, nearly neutralised with hydrochloric acid, a few drops of oxalate of ammonium added, again filtered, and the solution evaporated to dryness. The resultant chloride of potassium reduced to powder. The product was absolutely free from sulphates, completely soluble in water, and the solution was perfectly neutral. The salt showed no trace of sodium when heated on platinum wire in the Bunsen flame.

The hydrochloric acid used in the experiments was prepared by acting on common salt by non-arsenical sulphuric acid, and passing the washed gas into distilled water.†

The platinic chloride was obtained by reducing the commercial chloride (which contains iron and other impurities) by boiling with caustic soda and alcohol, thoroughly washing (first by decantation and afterwards on the filter) the resulting platinum black, boiling it for some time with hydrochloric acid, and again thoroughly wash-

* A shorter method than those tried would probably have been to ignite pure potassium chlorate.—A.H.A.

† For some years all the hydrochloric acid employed in my laboratory has been prepared by this process. It is more convenient, and furnishes a far superior product to that obtained by distilling the impure liquid acid.—A.H.A.

ng with hot water, and igniting in a muffle. The metallic platinum was boiled with nitric acid, re-washed and re-ignited, and then weighed and dissolved in aqua regia. The platinic chloride solution thus obtained was evaporated nearly to dryness, first with hydrochloric acid, and then several times with water, in order to get rid of the free acid as much as possible.* Ultimately the solution was diluted, filtered from any insoluble residue (which was ignited and weighed, and the weight deducted from the original), and the filtrate further diluted until 100 c.c. contained about 6 grms. of metallic platinum.

As the projected researches required that the weight of potassium salt used in each experiment should be known with the greatest possible accuracy, it was considered desirable to avoid direct weighing of the solid salt by employing a definite amount of solution of known strength. For this purpose the capacity of a pipette, which nominally held 10 c.c., was accurately ascertained. The pipette was filled to the mark with distilled water at a temperature of 20° to 21° C. The contents were then allowed to flow into a small accurately tared beaker. The pipette was then allowed to drain for exactly thirty seconds, when the last drop of fluid was expelled by gentle blowing, the nose of the pipette being held in contact with the beaker so as to avoid any chance of loss. This plan was found to result in the delivery of a more constant weight of fluid than spontaneous draining, with or without subsequent contact of the point of the pipette with the main volume of the liquid. The same pipette was always employed, and the contents were delivered in the same manner. All the measurements were made at pretty nearly the same temperature.

As a result it was found that in a series of nearly twenty experiments, the extreme variation in the weight of distilled water delivered was 8 milligrms., or about 0·08 per cent of the weight, while the great majority of the determinations were within 2 milligrms. of the mean. The result of using the pipette for measuring out 10 c.c. of a 10 per cent solution of chloride of potassium would be that the maximum deviation from the mean would be 0·04 per cent of the weight, though the maximum difference in two successive measurements might amount to twice this amount. The experiments showed that at 20° C. the pipette delivered a mean weight of 9·9329 grms. of distilled water. The most convenient quantity of chloride of potassium for precipitation with platinic chloride is about 0·7 grms. or 10 grains. A solution of pure chloride of potassium was therefore prepared of such strength that the pipette should deliver about that amount. The exact amount of chloride of potassium contained in one pipette delivery of the solution was next ascertained. Two determinations were made by precipitating a pipetteful with nitrate of silver, and one by direct evaporation of the liquid to dryness, with subsequent cautious heating of the residue—

A1. AgCl =	KCl 0·6968 grm.
A2. AgCl =	KCl 0·6971 ,,
B1. By evaporation =	KCl 0·6970 ,,

The mean of these closely concordant result is 0·69697 grm.; 0·697 grm. was therefore considered as the true amount of chloride of potassium in the solution delivered by the pipette.

At a somewhat advanced period of the investigations some irregularities in the results led to a doubt as to the degree of accuracy attainable by pipette measurements, and it was decided to commence an entirely new series of experiments on a different basis. Recognising the advantage the employment of solutions has over direct weighing of the solid salt, it was decided to *weigh* each quantity of solution employed, merely trusting to measurement to obtain approximately the same quantity. By proceeding in this manner all errors due to unequal deliveries of the pipette or accidental alterations of temperature were entirely eliminated.

For these experiments a fresh solution of chloride of potassium was prepared, by dissolving a known weight of the pure potassium chloride in exactly ten times its weight of distilled water.*

In the experiments made on the weighed, solution the required quantity was approximately measured by running it from a burette into an accurately tared beaker, and the *exact* quantity taken was then ascertained by weighing. In this manner the amount of potassium salt employed in each experiment was ascertained with great accuracy. The error in the amount taken could not be more than 0·00005 of a gramme, or about 0·007 per cent of the quantity used.

With the new solution the following experiments were made as a check on its strength :—

By precipitation with nitrate of silver :—

	Weight of Solution	= KCl.	Weight of AgCl	= KCl	= Per cent.
A 1.	7·7065	0·70060	1·3459	= 0·70017	= 99·94
A 2.	7·7455	0·70414	1·3534	= 0·70408	= 99·99

By direct evaporation :—

	Weight of Solution	= KCl.	Residue	= KCl per cent.
B 1.	7·7110	= 0·7010	0·7005	= 99·93

In this case half a milligramme loss of chloride of potassium, probably due to decrepitation on heating the residue, caused a difference of 0·07 per cent.

In the foregoing and all subsequent experiments the following atomic weights and factors were employed :—

Chlorine	35·475	Stas, 1865.
Potassium	39·137	,, ,,
Silver	107·930	,, ,,

$$AgCl \times 0{\cdot}52023 = KCl.$$

The atomic weight of platinum was calculated from the original data of Berzelius obtained by the analysis of potassium chloro-platinate, but substituting Stas' numbers for chlorine and potassium for those employed by Berzelius. This gives the result—

$$Pt'''' = 197{\cdot}1937.$$

Hence—

$$K_2PtCl_6 \times 0{\cdot}16033 = K_2$$
$$K_2PtCl_6 \times 0{\cdot}19310 = K_2O$$
$$K_2PtCl_6 \times 0{\cdot}30560 = 2KCl.$$

Fresenius, in the last edition of his "Quantitative Analysis" (7th English) adopts the number 98·59 as the atomic weight of di-valent platinum, which also gives the factor 0·3056 for calculating the chloro-platinate into chloride of potassium. In former editions Andrews's number of 98·94 was adopted for platinum, which caused a sensible difference in the percentage of potassium chloride obtained. The factor 0·30507, resulting from the employment of Andrews's atomic weight for platinum, is adopted by Drs. Frank and Berrand in their communication to this Committee. The consequence of employing the above factors in calculating the percentage of chloride of potassium corresponding to the precipitate of chloro-platinate obtained is shown in the following statement .—

	Precipitate	× Factor	= KCl per cent
Committee	3·2723	× 0·30560*	= 100·00
Fresenius	3·2723	× 0·30560	= 100·00
Frank and Berrand	3·2723	× 0·30507	= 99·83

* This method of preparing pure chloride of platinum is practically identical with that recommended by Messrs. Chalmers and Tatlock, in a paper read before the Chemical Section of the Philosophical Society of Glasgow, April 20th, 1868. The Committee has adopted the same process for recovering the platinum from the precipitates and filtrates obtained in the experiments.

* It is obvious that the subsequent calculations would have been facilitated by dissolving the salt in *nine* times its weight of water instead of *ten*. This consideration did not present itself till it was too late to take advantage of it.

* This factor was adopted by Messrs. Chalmers and Tatlock as long ago as 1868.

The committee is informed that the factor 0·194 is adopted by some chemists for calculating the chloroplatinate to anhydrous potash, a plan which would cause the result of 100·52 of chloride of potassium to be obtained instead of 100·00.

(To be continued.)

THE JABLOCHKOFF ELECTRIC CANDLE.

A SECOND series of experiments illustrating the lighting capabilities of this important invention took place on Friday evening last, at the West India Docks, in the presence of a large body of scientific gentlemen and others interested in this last addition to our illuminating appliances. On this occasion everything worked smoothly, and taking the experiments as a whole they were eminently satisfactory. The electric power was produced by one of the Paris *Alliance* Company's magneto-electric machines, with thirty-two horse-shoe magnets of seven plates each, and worked by a small agricultural engine of about eight horse-power.

The trials commenced at 9 o'clock with the lighting-up of the yard, which was described in our article (CHEM. NEWS, vol. xxxv., p. 238). Four lamps, mounted on posts about 15 feet high, were used, each of which were said to be equal to one hundred gas-lights, but the size of the gas-light was not specified. The lights were toned down by opal glass globes, which seemed somewhat too thick for the purpose, the light given out by the candles being, if anything, a little too subdued. The very slight flickering, of which we have already spoken, was much less apparent than on the occasion of the first trial—an improvement which was no doubt due to the engine being in better working order. It seems that a great deal depends on the motive power working regularly; for after the lamps had been burning for about five minutes the light suddenly improved, becoming much more steady and brilliant. After burning for about twenty minutes the lights were extinguished, and four gas-lamps, with four powerful burners to each, were turned on, evidently with the intention of showing the difference between the orange colour of the gas-flame and the pure white of the electric lamp. The company then adjourned to a large warehouse at the top of an adjacent building, measuring about 50 yards long by 25 yards wide, which was lighted from the outside by three electric candles without any intervening globes. Two of these candles were placed at the side and one at the end, but being only breast high the shadows of persons passing in front of them greatly interfered with the experiments tried. One of the objects of this portion of the trial was to ascertain whether this light could be used for sampling various descriptions of produce and merchandise. Several experts were present, but owing to the position of the light being horizontal instead of vertical there seemed to be some doubt as to its value in the case of samples of coffee, grain, pepper, and similar commodities, inasmuch as the strong shadow cast horizontally by the individual grains of the produce under examination interfered materially with their colour—the particular tint of a coffee berry, for instance, being an important factor in the estimation of the value of a sample. It was far otherwise with a number of samples of coloured alpaca goods. The most difficult colours to judge of by gas-light, or during foggy weather, are dark olive greens, puces, and blues. Next to these come the lightest shades of straw-yellow and cream-colour. In the first case the colours are not to be distinguished from black, and in the second from white; but under the electric light the darkest Navy blues and the lightest greys came out in their true tints, even to the eyes of the uninitiated. The company then adjourned to the quay below, alongside which a large barque had been moored. Here the practicability of lighting ships' decks and holds, and the adjoining wharfs, was most satisfactorily demonstrated, as well as the portability of the light itself.

The amount of heat given off by M. Jablochkoff's candle is comparatively small, the glass globe of one of the lanterns used for lighting up the ship having been found to be only just comfortably warm after having been lighted for twenty minutes.

The last experiment tried was, scientifically speaking, the most interesting of the whole, demonstrating as it did that M. Jablochkoff has succeeded in entirely doing away with the necessity for using carbons for the electric light. His newest form of candle consists of a thin plate of his kaolin composition, about 1¼ inches long by 1 inch broad, and about $\frac{1}{32}$th inch thick. The sides of the plate are inserted in grooves cut in the wires forming the electrodes of the battery, which project very slightly above the top of the plate. In order to light this new form of candle a bridge of ordinary graphite is carried along the top edge of the porcelain plate. The graphite becomes incandescent, causing the porcelain to melt, which then becomes a conductor. The graphite gradually disappears, and the melted portion of the porcelain becomes incandescent, gradually vapourising at the rate of a millimetre an hour. The light given out by the porcelain seems softer, mellower, and much more constant and steady, than that given off by the combination of carbon and porcelain: indeed after five minutes' examination with black spectacles we failed to discern anything more than a barely perceptible start at distant intervals.

Altogether MM. Jablochkoff and Denayrouze may be congratulated on the success which attended their very interesting series of trials on Friday night.

PROCEEDINGS OF SOCIETIES.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

June 11th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

DR. R. BIEDERMANN presented a communication on the "*Action of Phthalic Anhydride on Diamines.*" By melting the two substances together tolylene-diamine and phthalic anhydride yield $C_7H_6[N(CO)_2C_6H_4]_2$, melting at 104°, and $C_7H_6(NH)_2(CO)_2C_6H_4$, melting at 192°. These two phthalyl-tolylene-diamines result in all cases also when various dehydrating agents are used. The solubility of the first in alcohol, and of the other in acetic acid, permits an easy separation. Alkalies decompose the compounds into tolylene-diamine and phthalates. Perfectly analogous bodies are yielded also by the diamidobenzenes.

DR. A. PINNER has found a "*Hexyl Chloral*, $C_6H_9Cl_3O$," among the by-products yielded in the preparation of croton chloral, boiling at 212°, and uniting neither with water nor CNH. It possesses no special action on the animal organism. Nitric acid changes it into trichlorocaproic acid, $C_6H_9Cl_3O_2$, insoluble in water, and reducible by zinc to a hexylenic acid, $C_6H_{10}O_2$, isomeric, if not identical, with the ethyl-crotonic acid of Frankland and Duppa. Allylene tetrachloride was found to be present in considerable quantities in crude croton chloral.

DR. A. PINNER and FR. FUCHS, "*Derivatives of Chloral.*" Chloral-acetyl-cyanide, $CCl_3.CH(OC_2H_3O).CN$, was obtained by the action of acetic anhydride on chloral-cyanhydrate. This compound yields with H_2SO_4, acetyltrichloro-lactamide; with aniline, dichloro-acetanilide; with acetate of aniline, mono-chlor-acetanilide; with NH_3, dichlor-acetamide; and with ammonium acetate, dichlor-

acetic ether. Chloral-cyan-hydrate itself gave with H_2SO_4 trichloro-lactamide; with acetate of aniline, trichlor-ethyliden, diphenyl-diamine; and with urea, dichlor-acetyl-guanidine. Ammonium acetate and chloral hydrate yield trichlor-ethylidene-imide, $CCl_3.CHNH$, the first imide of the composition, X.CHNH as yet prepared.

The following communications have been received from non-resident members:—

E. Linnemann, "*On Propylene*." The author shows the inability of propylene to unite with H_2O at 100° and form propyl alcohol.

"*Acrylic Acid*." It is found that by melting sodium acrylate with alkalies hydrochloric acid and lactic acid are produced, the former yielding by decomposition acetic acid and formic acid.

A. Baeyer describes at length "*Oxy-phthalic Acid*, $C_8H_6O_5$." It is obtained in the form of the ether by the action of $NaNO_2$ on the ether of amido-phthalic acid. The acid itself crystallises in colourless rosettes, melts at 180°, is easily soluble in boiling water and ordinary solvents, forms easily soluble salts, and changes into the anhydride on fusion. It resembles phthalic acid in general, and forms oxyphthaleins with phenol, resorcin, &c., closely allied to the phthaleins. The position of the HO group has not been determined.

C. Böttinger, "*On Glyoxylic Acid*." This acid yields on treatment with HCN glycollic acid and CO_2; and by means of Perkin's reaction with acetic anhydride and sodium acetate, oxalic and glycollic acids.

R. Fruhling and J. Schulz describe a "*New Method of Preparing Betain*, $C_3H_{11}NO_2$, from the mother-liquor obtained in Scheibler's treatment of molasses. By the addition of a mixture of H_2SO_4 and alcohol, lime and potash are precipitated, while betain and the organic acids are dissolved in the alcohol. The separation of the betain from this solution is performed by means of a stream of HCl gas, and depends on the insolubility of the hydro-chlorate in alcohol containing HCl. Pure betain is obtained by the action of Ag_2O on the aqueous solution of the hydrochlorate.

G. Lunge, "*Estimation of Nitrous and Nitric Acids*." A series of comparative experiments tend to show that HNO_3 is determined more accurately by the method of oxidation with iron, and titration of the unoxidised residue with a solution of potassic permanganate, than by Siewert's method (reduction in alkaline solution with Zn and Fe). Titration with potassic permanganate is regarded as the only reliable process for determining nitrous acid. Hart's method with urea, with Crowder's modifications, as well as other methods, all failed to give as accurate results when tried on a solution of pure $AgNO_2$ in concentrated H_2SO_4. The determination of the two acids in the same solution is performed by first titrating the nitrous acid with permanganate, and then proceeding as above for the nitric acid.

H. Panisch has prepared "*Para-tolyl-phenyl-acetic Acid*, $(C_6H_5)(CH_3C_6H_4)CH.CO_2H$," by the action of toluen and zinc on phenyl-bromo-acetic acid, accompanied by small quantities of the ortho acid. Oxidation changes it into tolyl-phenyl-ketone, and para-benzoyl-benzoic acid.

T. Zincke, "*Chlorides of Hydro-benzoin and Iso-hydro-benzoin*." These two alcohols yield with PCl_5 and PCl_3 identical chlorides, $C_{14}H_{12}Cl_2$, hydro-benzoin, forming also a second isomer. All of these chlorides yield on regeneration of the alcohols iso-hydro-benzoin accompanied by but microscopic quantities of hydro-benzoin.

C. Wachendorff and T. Zincke obtain "*Styrolen Alcohol* (*Phenyl-glycoll*), $C_6H_5.CHOH.CH_2OH$," by treating styrolen bromide with $AgNO_3$ or $C_2H_3O_2K$, and saponifying the ether formed. No isomer was observed. The alcohol crystallises in needles, and is easily soluble in water. Several ethers have been prepared.

O. Jacobsen, "*Extraction of Xylens from Tar*." By warming that portion of the crude xylols obtained from tar (which does not dissolve in ordinary sulphuric acid) with fuming acid, para-xylol is separated out in the form of the sulphonic acid, from which heating at 195° with HCl releases the hydrocarbon. The portion dissolved in ordinary sulphuric acid contains the meta- and ortho-xylens. On addition of $NaCO_3$ the sodium salt of ortho-xylen sulphonic acid crystallises out, and leaves the meta-salt in the mother liquor.

J. Thomsen, "*Heat of Solution of* Cl, Br, *and* I *Compounds*." The author gives the tabular results of his experiments on eighty-six different bodies. The anhydrous compounds dissolve in water partially with absorption, and partially with development of heat. Tl_2Cl_2 and Al_2Cl_6 represent the two extremes. Those compounds dissolving with development of heat form crystalline compounds with water. The hydrous salts show, with but few exceptions, an absorption of heat on solution. The heat of solution of the anhydrous salts increases with the atomic weight of the electro-negative components, and with the decreasing atomic weight of the electro-positive components, *i.e.*, is greater for I than Cl, for Mg than Ba. The same author shows that uniform laws hold good for the formation of ethers, and for the partial decomposition of salts in aqueous solutions by acids.

L. Brieger detects among the "*Volatile Constituents of Human Excrement*" acetic acid, butyric and isobutyric acids, phenol, indol, and a new substance—Skatol—allied to indol, and forming the chief portion of the aromatic fraction. Skatol is a white crystalline body, not so soluble as indol, and when injected beneath the skin enters as a colouring matter into the urine.

M. Nencki, "*On the Processes of Decay*." By the distillation of old Roquefort cheese with sulphuric acid a volatile oil is obtained, to which the cheese owes its peculiar odour and taste. It is yellow, reacts neutral, and possesses a sharp burning taste.

L. Liebermann, "*On Nitro-benzoic Acids*." In response to the late paper of Fittica on this subject (Chemical News, vol. xxxv., p. 142), the author states that he has obtained an acid corresponding to Fittica's fourth isomeric nitro-benzoic acid, melting at 127°, by preparing the Ba salt of the nitration products of benzoic acid, decomposing with HCl the first portion of the salt which crystallises out, changing this acid into a Ba salt, and repeating the process several times. After obtaining the acid melting at 127° the process was continued, and it was found to consists of a mixture of the three known nitro-benzoic acids. Further experiments were made on the melting-points of mixtures of acids, which showed that they are always lower than that of the lowest melting acid in the mixture, if equivalent quantities are taken, and under all circumstances lower than the highest.

L. B. Hall and I. Remsen obtain a "*Para-sulphamic-mesitylic Acid*, $C_6H_2.(CH_3(2.COOH.SO_2NH_2$," by the oxidation of mesitylen-sulphamide. The groups SO_3H and COOH are regarded as in the ortho position, on account of the impossibility of obtaining anortho-sulpho-benzoic acid from the ortho-toluolen sulphonic acid.

M. W. Iles and I. Remsen have examined the "*Oxidation Products of the Sulphonic Acids of Meta-xylol*." Xylol-sulphamide melting at 110° yielded a sulphamine-meta-toluic acid, $C_6H_3.SO_2NH_2.CH_3.COOH$, regarded as possessing the position 1, 2, 4. The amide melting at 132° is decomposed entirely by oxidation.

E. Hart and I. Remsen have obtained "*Two Isomeric Sulphonic Acids from Para-nitro-toluen*" by the action of fuming H_2SO_4, instead of the single one described by Beilstein and Kuhlberg. They are formed in about equal quantities, and are divided by the varied solubilities of the calcium salts.

F. Japp and G. Schultz has discovered "*Methyl-anthracen*, $C_{14}H_{19}.CH_3$," in small quantities, accompanying anthracen and phenanthren in coal-tar. Oxidation changed it into anthraquinon-carbonic acid, $C_{15}H_8O_4$.

OBITUARY.

JOHN JOSEPH GRIFFIN.

The regret with which we record the death of Mr. John Joseph Griffin will be shared by many of our readers. By designing or manufacturing new apparatus for laboratory use, and by effecting improvements which the adoption of more accurate methods of analysis or more refined methods of research had rendered necessary, he contributed in no small degree to the advancement of chemical science.

He was born in London in 1802, and was brought up to the trade of bookseller in the well known firm of Messrs. Tegg and Co. When still a young man he set up in business for himself at Glasgow as bookseller and dealer in chemical apparatus; subsequently returning to London, where he established the firm of Messrs. Griffin and Sons. He was one of the founders of the Chemical Society, and author of several works in connection with the science—"Chemical Recreations," "Radical Theory in Chemistry," &c.—all of which have been reviewed in our pages. He died June 9th, aged 75, and was interred at Nunhead Cemetery.

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—Permit me to correct some most erroneous impressions that must have arisen in connection with the above subject, owing to a communication from my brother, M. M. Pattison Muir, of Owens College, to you (Chem. News, vol. xxxv., p. 94).

Located as I am at the Antipodes your paper has but just come to hand; hence the delay in correcting the matter.

The experiments my brother speaks of were instituted and performed personally by Prof. Liversidge, some months before I became his private assistant. After I occupied that position I merely worked out the practical details of the later determinations, under the personal supervision of Prof. Liversidge, and the information conveyed to my brother in confidence, in a private letter, was never meant for publication. The results of the investigation belong to Prof. Liversidge, and not to me, as my brother's letter might lead your readers to imagine.—I am, &c.,

Jno. M. Muir.

University, Sydney, N. S. W.,
May 27, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Gazzetta Chimica Italiana.
Anno vii., 1877, Fascicolo iv. e v.

Elasticity of Metals at Different Temperatures.—G. Pisati.—The concluding portion of a long memoir consisting chiefly of tables and formulæ.

On a New Acid extracted from "Lecanara atra."—E. Paterno and A. Oglialoro.—The lichen in question has been obtained from the mountains surrounding the western part of Palermo. The acid crystallises from its boiling solution in chloroform in small, colourless, transparent crystals. It is very sparingly soluble in cold ether and alcohol, dissolves rather more freely in benzol and alcohol at a boil. It is slightly soluble in cold chloroform, and moderately in the same medium when hot. It melts at 190°, and its composition may be expressed by the formula $C_{19}H_{18}O_8$. It has the characters of a feeble acid.

New Researches on Picrotoxin.—E. Paterno and A. Oglialoro.—The authors have obtained and analysed picrotoxide, $C_{15}H_{16}O_6$; mono-bromo-picrotoxide, $C_{15}H_{15}BrO_6$; the hydrate of picrotoxide, $C_{15}H_{18}O_7$.

Constitution of Chloral Ammonium and of Aldehydate of Ammonium.—R. Schiff.—In this paper, which is chiefly of a hypothetical character, the author treats of the preparation of chloral ammonium, its reaction with chloride of acetyl or anhydrous acetic acid; and the action of chloride of acetyl upon mono-acetyl-chloral ammonium.

Constitution of Cyanamid.—M. Filetti and R. Schiff.—This paper, which is also of a hypothetical nature, gives an account of the addition products of cyanamid with chloral.

Colouring-matter of "Boletus luridus."—Dr. G. Cugini.—In this preliminary paper the author gives the following conclusions:—That the chromatogenous matter of *Boletus luridus* is not aniline, as Phipson considers, and that it seems to be of an acid nature, and capable of yielding a blue salt with ammonia. Its most characteristic reactions are with ammonia and with iodine. It is completely insoluble in ether, and it seems to be the cause of the green colouration imparted to the substance of the fungus by the salts of iron and of tin.

Fluoride of Magnesium.—Alfonso Cossa.—After giving a survey of our previous knowledge of this compound, the author states its composition, as found in his analyses, as—

Magnesium ..	39·21	38·94	38·71
Fluorine	60·79	61·06	61·29
	100·00	100·00	100·00

corresponding to the formula MgF_2.

Colouring-matter of "Velella limbosa."—A. and G. De Negri.—Haxing studied the purple of the *Murex*, in which they have discovered indigotin and a red matter analogous to indigo-red, the authors had examined the blue colouring-matter of *Vellela limbosa*, an oceanic mollusk, sometimes driven on shore by the winds. The colouring-matter is blue with a slight purple cast, very fugitive, fading rapidly with the death of the animal. It is insoluble in ether, chloroform, benzol, and bisulphide of carbon, but dissolves in water, and the solution becomes yellow on boiling. Acids turn it red; alkalies render it an amethystine rose, which acids do not re-convert to the original blue. It is bleached by chloride of lime and by oxygenated turpentine; acetone and essence of bitter almonds turn it red. Its spectrum has nothing remarkable, and it is at once distinguished from the purple of the *Murex* and the colouring-matter of *Aplisia* by the absence of absorption-bands.

On an Easy Process for Detecting Minute Traces of Copper.—L. Cresti.

Electolytic Determination of Zinc and Lead in Minerals and in Artificial Products.—G. Parodi and A. Mascazzini.

These two papers are reserved for insertion in full.

Portable Apparatus for Volumetric Analysis.—F. Sestini.—The description of the apparatus cannot be made intelligible without the accompanying engraving.

MISCELLANEOUS.

The Supposed Mercurial Poisoning by Coloured Vulcanite.—An impression has long prevailed that it was possible for the salts of mercury, used to colour red vulcanite, to exert a poisonous influence where red rubber plates were worn in the mouth; and the attention of the

Odontological Society having been strongly drawn to the subject by Dr. Bathurst Woodman's papers (see *Trans. Odont. Soc.*, 1875), relating cases of supposed mercurial poisoning from this cause, a committee was appointed to collect evidence and report upon the subject. Their inquiries have however utterly failed to establish the existence of a single case of unquestionable, or even probable mercurial poisoning due to the use of red vulcanite plates. The committee requested Professor Attfield to make "an investigation of the influence, if any, of saliva and the other fluids of the human body on the pink and red varieties of vulcanite used by dentists in making artificial teeth-plates, gums, and palates." These tinted varieties of vulcanite are made by heating pink or red "dental rubber," under pressure, to a temperature of 310° to 315° F. (154° to 157° C.), the "dental rubber" being prepared by incorporating sulphur and vermillion with pure india-rubber. The following are the results of Dr. Attfield's investigation—1. So far as any action on man is concerned vermillion is a harmless substance. 2. So far as any effect or influence of the vermillion is concerned, the mixture of vermillion, sulphur, and indiarubber, commonly termed "dental rubber," is also a perfectly innocuous substance. 3. Pink or red dental vulcanite, even when placed under the severest conditions of experiment, does not yield any trace of mercury to saliva, or, indeed, to other far more powerful solvents. 4. The metallic pins and braces in dental vulcanite do not displace mercury, or induce the formation of any compound of mercury soluble in saliva or in more powerful solvents. Dr. Attfield is therefore of opinion that vermillion vulcanite teeth-plates are practically unaffected by saliva, or by any substance which ever gains access to the mouth; and, in short, that the pink and red vulcanite artificial gums and palates now so generally worn are absolutely harmless.

NOTES AND QUERIES.

Organic Principles of Plants.—Could you advise me a book which treats upon the organic constituents of plants in a thoroughly scientific manner? I have two very useful books but they hardly say enough on the subject; they are as follows:—"Schleiden's Botany" and "Schorlemmer's Chemistry of Carbon Compounds."

MEETINGS FOR THE WEEK.

SATURDAY, 23rd.—Physical, 3. "Applications of Melloni's Apparatus to Clifton's Optical Bench, and Interference of Light by Thick Plates," by Prof. W. G. Adams, F.R.S. (Adjourned Special General Meeting.)
MONDAY, 25th.—Royal Geographical, 8.30.
TUESDAY, 26th.—Anthropological Institute, 8
WEDNESDAY, 27th.—Society of Arts, 4. Anniversary.

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THE CHEMICAL NEWS.

Vol. XXXV. No. 918.

ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 256.)

152. The following experiments were tried with a very sensitive radiometer in a 2-inch bulb. The moving part (the "fly"), consisting of glass arms, pith disks, and steel point, weighed only 0·8 grain. It was exhausted with a charcoal reservoir attached (131).

A standard candle, placed 2 inches from the centre, made the arms spin with a velocity of 4 revolutions per second; with the candle 4 inches off the velocity was 10 revolutions in 11 seconds. In the full sunshine of a November day the speed was too great to count. Nothing was visible but an undefined nebulous ring, which became more or less distinct as the sunlight increased and diminished owing to passing clouds. This speed was kept up for more than an hour; indeed there appears no reason why it should ever diminish as long as light of uniform intensity shines on it.

153. The same radiometer was tried by the light of a candle, 4 inches off, behind different screens, with the following results:—

1 Candle, 4 inches off –	Seconds for 1 Revolution.
Naked flame	1·1
Behind thin white glass	1·3
,, thick plate glass	1·4
,, purple glass	1·5
,, dark red glass	1·5
,, pink glass	1·6
,, light yellow glass	2·1
,, blue glass	2·5
,, orange glass	2·7
,, green glass	3·0
,, "eclipse" glasses (blue and orange), almost opaque to daylight	4·0
,, 7½ millims. of water in cell	6·0
,, solution chromate of potash, 7½ millims. thick	6·0
,, sol. bichromate of potash, 7½ m.m. thick	7·0
,, clear plate of alum, 5 m.m. thick	9·0
,, sol. chloride of cobalt, 7½ m.m. thick	12·0
,, sol. ferrocyanide of potassium, 7½ m.m. thick	16·0
,, sol. ammonio-sulphate of copper, 7½ m.m. thick	20·0
,, sol. ferricyanide of potassium, 7½ m.m. thick	30·0
,, sol. sulphate of nickel, 7½ m.m. thick	35·0
,, sol. sulphate of copper, 7½ m.m. thick	39·0

154. The instrument is thus seen to be capable of very extended use as a measurer of radiation of any desired kind. Unlike the instrument described in paragraph 135, it cannot be used for actually balancing one quality of light against another; and the method of taking an observation is not so accurate, for it is less easy to count revolutions per second or per minute than to observe the movement of a spot of light along a graduated scale. There are besides many causes which tend to interfere with the accuracy of the indications of this form of instrument. But, notwithstanding these drawbacks, I think the radiometer is likely to be a more popular form of light-measurer. It requires no adjustment, and is always ready to be observed, whilst there is a peculiar charm in using an instrument which is constantly in active work. With the exception of the comparison by balancing one light against another, all the observations mentioned in paragraph 140 can be taken with the radiometer, and it is besides capable of applications of its own. I will mention one, although others easily suggest themselves.

As the radiometer will revolve behind the orangecoloured glass used by photographers for admitting light into their so-called dark-room, it is only necessary to have one of these instruments in the window to enable the operator to see whether the light entering his room is likely to injure the sensitive surfaces there exposed; thus, having ascertained by experience that his plates are fogged or his paper injured when the revolutions exceed, say, one in three seconds, he will take care to draw down an extra blind when the revolutions approach that number. In photographic operations a radiometer may be placed in some convenient spot near the object to be copied. Having ascertained, once for all, how many revolutions the instrument makes whilst a good negative is being taken, the operator need in future take no account of the variation of light, but simply expose for the same number of revolutions, with a certainty that his negatives will all be of the same quality.

For the more important work of gas-testing probably the bar-instrument already described (135) will be more valuable; although, even for this purpose, the radiometer will be found to give very rapid and trustworthy indications.

155. I have already mentioned that the motion of the radiometer depends on a differential action of radiation on the black and white surfaces. To obtain rotation in the ordinary way the black must be repelled with more energy than the white; and this appears to be the case with all the luminous rays. In the case of dark heat, however, this difference of action is not apparent (128). The following experiments were tried with various radiometers:—

A candle was placed at such a distance from a radiometer that the fly would make one revolution a minute. A small glass flask of boiling water was then placed half an inch from the bulb. The revolutions instantly stopped, two of the arms setting equi-distant from the hot-water flask. The candle was kept in the same position, and the flask of water was removed. As the portion of the bulb which had been heated by the hot water cooled, the white surface gradually crept nearer and nearer to it, the superior repulsion of the candle on the black disks urging the arms round and acting in opposition to the repulsion of the hot glass to the white disk. At last the force of the light drove the white disk with difficulty past the hot spot of glass. Rotation then commenced, but for some revolutions there appeared to be a difficulty in the white disks passing the spot of glass which had been warmed by the hot water.

156. The flask of boiling water was then replaced in its position half an inch from the bulb of the radiometer. The rotation immediately stopped. The candle was then brought gradually nearer and nearer to the instrument, but with no particular effect. As it came very near the arms vibrated to and fro, and appeared to make violent efforts to get round, but no force of the light seemed sufficient to overcome the repugnance of the white disk to pass the heated portion of the glass.

157. The radiometer was allowed to cool, and the candle was again placed in the first position, where it produced one revolution in a minute. The finger was pressed against the side of the bulb. As the spot of glass got warm the white surface experienced more and more difficulty in getting past it, until at last one disk refused to pass, and the arms came to rest.

* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

The instrument was again allowed to cool, and the revolutions re-commenced at the usual speed (the laboratory in which this was tried was somewhat cold). I then came from a warm room, and stood a foot from the radiometer, watching it. In about a minute the radiant heat from my body had warmed the side of the bulb nearest to me sufficiently to cause an appreciable difficulty in the movement, and soon the revolutions stopped. The same effect has been observed if the radiometer is brought into a very warm room, and placed near a cold window. If the daylight is feeble, the instrument not very sensitive, or an observer stands near the instrument, an appreciable sticking is observed as the white disks come near that part of the bulb which is the warmest.

These experiments show that dark heat has quite a different action from that of the luminous rays. They also show that many precautions are necessary to guard against the interfering action of unequal heating of the radiometer when it is being used for accurate measurements.

158. Having found such an antagonistic action of dark heat, I tried the action of ice. This, I have already shown (33, 88), is equivalent to warming the opposite side of the instrument. A piece of ice brought near the radiometer on one side cuts off the influx of heat to it from that side, and therefore allows an excess of heat to fall upon it from the opposite side.

The same radiometer that I used in the experiments with boiling water (155) was mounted with a candle the same distance off as before, so that one revolution took place in one minute. A lump of ice was now brought within half an inch from the bulb on the opposite side to the candle. The revolutions got slower, each arm as it passed seeming drawn toward the ice, and having a difficulty in moving away from it. At last the movement stopped altogether, an arm pointing direct to the ice, and being apparently held there by a powerful attractive force. Bringing the candle nearer caused the arms to oscillate a little; and when it was almost close to the bulb the force of the light overcame the action of the ice, and the arms revolved again, but irregularly and with jerks, the disks moving quickly to the ice and leaving it with difficulty. In this action of ice no preference was noticed for either the black or white surface.

159. A very delicate radiometer, in 2-inch bulb (152), was placed in a light just sufficient to see it distinctly by, but not enough to cause it to move. I then came out of a warm room and stood near it. In a few seconds it began to move slowly round, *but the motion was negative*, i.e., the black disks advanced instead of retreated—the action of the radiation of low intensity from my body being apparently to repel the white surface more than the black. On moving away from the instrument the rotation gradually stopptd. I now came near it again, and held one hand an inch from the bulb. Rotation soon commenced, but still in the reverse way. These experiments were repeated several times and on different evenings with the same results.

160. When the instrument was at rest I came quickly to it, and gently breathed on the bulb. There was a slight movement in the normal direction, but this stopped directly, and the arms commenced to revolve the negative way, and kept on in the same direction for more than a minute, performing three or four complete revolutions.

161. A glass shade 4 inches diameter was held over a gas-flame till the air inside was warm and the inner surface dim with steam. It was then inverted over the radiometer. Negative rotation commenced, and kept up for several minutes.

The glass shade was then dried inside, and heated uniformly before a fire, until it had a temperature of about 50° C. It was then inverted over the radiometer. Negative rotation instantly commenced, and kept up with some vigour for more than five minutes, diminishing in speed until the shade had cooled down to the temperature of the surrounding air.

162. The same experiment was repeated, and whilst the arms were in full rotation a lighted candle was slowly brought near it. When 3 feet off the negative rotation slackened. When the candle was about 2 feet off the arms became still, and when nearer than 2 feet the instrument rotated normally. The antagonism between the action of the hot shade and the lighted candle was perfect; by moving the candle to and fro it was easy to cause the radiometer to move in one direction or the other, or to become still. These experiments were repeated many times, always with the same result. The perfect obedience of the instrument to the opposing forces, according as one or the other was in excess, was very striking. I may mention that only some of my radiometers act in this manner. It seems to require extreme lightness and great perfection of vacuum. The movable parts of the radiometer which shows this action best only weigh 0·53 grain.

(To be continued.)

ON THE

DETERMINATION OF ALUMINA AND FERRIC OXIDE IN PRESENCE OF PHOSPHORIC ACID.

By M. H. PELLET.

To an acid liquid containing phosphoric acid, alumina, and ferric oxide, we add in excess chloride of calcium (the lime calculated in the state of $PO_5 3CaO$). We add ammonia; there is formed tribasic phosphate of lime, alumina, and oxide of iron. We calcine and weigh. The residue may be dissolved in hydrochloric acid and the phosphoric acid determined by uranium in a part of the liquid. In another part of the liquid we determine iron by protochloride of tin (F. Weil's process). From the weight of the iron we find Fe_2O_3, and from that of phosphoric acid $PO_5,3CaO$.

The difference between the weight of these two bodies and the original weight gives the alumina. If we cannot determine phosphoric acid by uranium the determination of this acid may be done by direct analysis. This process should be used only where it is necessary to determine the phosphoric acid, iron, and alumina, or, at least, phosphoric acid and alumina, the useless weight of the iron being determined very rapidly.

If, in the liquid containing PO_5,Al_2O_3,Fe_2O_3, we have sulphuric acid, we ought to separate this latter to avoid the possibility of sulphate of lime being precipitated along with $PO_5 3CaO$, Al_2O_3, and Fe_2O_3. The separation is effected by baryta. In the filtrate an excess of baryta is not injurious if we take care to add a salt of lime in sufficient quantity to precipitate all the phosphoric acid in the state of tricalcic phosphate.—*Bulletin de la Société Chimique de Paris.*

REPORT

ON THE METHODS EMPLOYED IN THE

ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,

AND ON THE

MODE OF STATING THE RESULTS.†

(Continued from p. 262.)

With the view of testing the relative accuracy of the different modifications of the platinum process when ap-

† Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

plied to the estimation of potassium in the form of pure chlorides, the following experiments were performed:—The letters P and W refer to the mode of taking the required quantity of chloride of potassium: P signifying pipette measurement and W the weighing of the solution used. In the former case the percentage of chloride of potassium was obtained by calculating the chloroplatinate precipitate to potassium chloride, dividing the result by 0·697, and multiplying by 100. When a weighed quantity of platinum chloride solution was employed the following equation was used for calculating the percentage of chloride of potassium found,—S is the weight of solution used and P that of the precipitate obtained.

$$\frac{P \times 0{\cdot}3056 \times 11 \times 100}{S} = \frac{P \times 3361}{S} = \text{percentage of KCl found.}$$

Results bracketed together in the following tables were obtained from experiments executed side by side.

TABLE I.

Results of Experiments on Pure Chloride of Potassium, using Considerable Excess of Platinum Solution.

Expt.	Process.	KCl taken.	Weight of Precipitate.	KCl Per cent.	
1.	I. Fresenius ..	0·70072	2·3039	100·48	W.
2.	,, ..	0·70490	2·3156	100·39	
3.	III. Frank and Berrand ..	0·70150	2·3092	100·60	W.
4.	,, ..	0·70310	2·3118	100·48	
5.	IV. Tatlock ..	0·69700	2·2793	99·94	P.
6.	,, ..	0·69700	2·2792	99·93	P.
7.	,, ..	0·69700	2·2787	99·91	P.
8.	,, ..	0·70118	2·2947	100·01	W.
9.	,, ..	0·70140	2·2945	99·98	

These results, as far as they go, are decidedly in favour of Tatlock's method, and conclusively prove that it is capable of great accuracy.

At a later period of the investigations it was supposed that the excessive results obtained by some of the methods might be due to the fact that a very considerable excess of platinum solution was employed, a condition not in accordance with the directions of Fresenius and of Frank, but essential to Tatlock's method. The experiments made to elucidate this point did not immediately succeed those already detailed, but it is convenient to record the results here rather than in another place.

In the following experiments the quantity of platinum solution employed was but slightly in excess of the amount required to convert the whole of the platinum into chloroplatinate:—

TABLE II.

Results of Experiments on Pure Chloride of Potassium by Processes I. *and* III., *Employing only a* Slight *Excess of Platinum Solution.*

Expt.	Process.	KCl taken.	Weight of Precipitate.	KCl Per cent.	
10.	I. Fresenius ..	0·70164	2·2915	99·81	W.
11.	,, ..	0·69996	2·2875	99·87	
12.	,, ..	0·70227	2·2947	99·85	
13.	,, ..	0·70114	2·2931	100·08	W.
14.	,, ..	0·70150	2·2985	100·18	
15.	,, ..	0·70741	2·3218	100·30	W.
16.	,, ..	0·70877	2·3262	100·30	
17.	III. Frank.. ..	0·20291	0·6633	99·90	W.
18.	,, ...	0·20291	0·6637	99·97	
19.	,, ...	0·20037	0·6573	100·25	W.
20.	,, ...	0·20009	0·6553	100·05	
21.	,, ...	0·20377	0·6677	100·13	W.
22.	,, ...	0·20109	0·6576	100·23	

These results showed a great improvement, and indicated pretty clearly the importance of avoiding a large excess of platinum solution when alcohol only was employed for washing the chloro-platinate.

The following table shows the relative accuracy and limits of variation obtained in experiments on pure chloride of potassium by methods I., III., and IV.

TABLE III.

Analysis of the Results Obtained in the Estimation of Potassium when in the form of Pure Chloride.

Process.	No. of Expts.	Highest Result.	Lowest Result.	Average.
I. Fresenius—				
With *large* excess of platinum solution	2	100·48	100·39	100·44
With *slight* excess do. ..	7	100·30	99·81	100·06
II. Frank and Berrand—				
Large excess of Pt solution	2	100·60	100·48	100·54
Slight ,, ,, ,,	6	100·25	99·90	100·09
IV. Tatlock—				
Large excess of Pt solution	5	100·01	99·91	99·95

From these experiments, therefore, it was concluded that the method of estimating potassium by precipitation as chloro-platinate was very accurate when proper precautions were taken.

This conclusion is generally accepted, the chief discrepancies arising when mixed alkaline chlorides are analysed, the different methods then giving results which sometimes exhibit wide variations.

The following table shows the results obtained by the analysis of various mixtures of the pure chlorides of potassium and sodium:—

TABLE IV.

Results of Experiments on Mixtures of Pure Chlorides of Potassium and Sodium.

A. Using Considerable Excess of Platinum.

Expt.	Process.	KCl taken.	NaCl taken.	KCl Found per 100 parts taken.	
23.	I. Fresenius ..	0·3502	0·350	100·59	W.
24.	,, ..	0·3543	0·355	100·84	
25.	,, ..	0·3519	0·350	100·66	
26.	,, ..	0·3503	0·350	100·70	W.
27.	,, ..	0·3520	0·350	100·75	
28.	,, ..	0·3524	0·350	100·73	
29.	II. Fresenius mod.	0·6970	0·154	100·34	P.
30.	,, ,,	0·6970	0·154	100·54	
31.	,, ,,	0·6970	0·154	100·35	P.
32.	,, ,,	0·6970	0·154	100·46	
33.	,, ,,	0·3485	0·350	100·53	P.
34.	,, ,,	0·3485	0·350	100·99	P.
35.	,, ,,	0·3485	0·350	100·83	
36.	,, ,,	0·3485	0·350	100·47	P.
37.	,, ,,	0·3485	0·350	100·47	
38.	IV. Tatlock	0·6970	0·154	100·11	P.
39.	,, ...	0·6970	0·154	100·19	
40.	,, ...	0·6970	0·154	100·15	P.
41.	,, ...	0·6970	0·154	100·25	
42.	,, ...	0·3485	0·350	99·34	P.
43.	,, ...	0·3485	0·350	99·20	P.
44.	,, ...	0·3485	0·350	99·60	P.
45.	,, ...	0·3485	0·350	99·44	P.
46.	,, ...	0·3509	0·350	99·73	W.
47.	,, ...	0·3510	0·350	99·82	
48.	,, ...	0·3505	0·350	99·97	
*49.	,, ...	0·7053	0·350	99·45	W.
*50.	,, ...	0·7007	0·350	99·66	W.

* Experiments 49 and 50 were made on a special solution containing about 2 parts of KCl to one of NaCl. These two determinations were made by Mr. W. Galbraith, who has had much experience in the determination of potassium by Tatlock's method.

B. Using Slight Excess of Platinum, above that required to convert all the K and Na into chloro-platinates.

Expt.	Process.	KCl taken.	NaCl taken.	KCl Found per 100 parts taken.	
51.	I. Fresenius ..	0·35273	0·350	100·23	W.
52.	,, ..	0·35209	0·350	100·04	W.
53.	,, ..	0·35150	0·350	99·72	W.
54.	,, ..	0·35250	0·350	99·77	
55.	III. Frank & Berrand	0·20000	0·200	100·40	W.
56.	,, ,,	0·20123	0·200	100·30	
57.	,, ,,	0·20177	0·200	100·02	W.
58.	,, ,,	0·20064	0·200	100·28	
59.	,, ,,	0·20291	0·200	102·14	W.
60.	,, ,,	0·20359	0·200	102·09	

TABLE V.

Comparison of the Actual Composition of Mixtures of Potassium and Sodium Chlorides with the Results Obtained.

A. Large Excess of Platinum.

Expt.	Process.	KCl taken. p. c.	NaCl taken. p. c.	KCl obtained. p. c.	Error.
23.	I. Fresenius ..	50	50	50·29	+0·29
24.	,, ..	50	50	50·42	+0·42
25.	,, ..	50	50	50·33	+0·33
26.	,, ..	50	50	50·35	+0·35
27.	,, ..	50	50	50·37	+0·37
28.	,, ..	50	50	50·36	+0·36
	Average				+0·35
29.	II. Fresenius mod.	82	18	82·28	+0·28
30.	,, ..	82	18	82·44	+0·44
31.	,, ..	82	18	82·29	+0·29
32.	,, ..	82	18	82·38	+0·38
33.	,, ..	50	50	50·26	+0·26
34.	,, ..	50	50	50·49	+0·49
35.	,, ..	50	50	50·41	+0·41
36.	,, ..	50	50	50·23	+0·23
37.	,, ..	50	50	50·23	+0·23
	Average				+0·34
38.	IV. Tatlock ..	82	18	82·09	+0·09
39.	,, ..	82	18	82·15	+0·15
40.	,, ..	82	18	82·12	+0·12
41.	,, ..	82	18	82·20	+0·20
42.	,, ..	50	50	49·67	−0·33
43.	,, ..	50	50	49·60	−0·40
44.	,, ..	50	50	49·80	−0·20
45.	,, ..	50	50	49·72	−0·28
46.	,, ..	50	50	49·86	−0·14
47.	,, ..	50	50	49·91	−0·09
48.	,, ..	50	50	49·98	−0·02
49.	,, ..	67	33	66·63	−0·37
50.	,, ..	67	33	66·77	−0·23
	Average				−0·11

B. Slight Excess of Platinum.

Expt.	Process.	KCl taken. p. c.	NaCl taken. p. c.	KCl obtained. p. c.	Error.
51.	I. Fresenius ..	50	50	50·11	+0·11
52.	,, ..	50	50	50·47	+0·47
53.	,, ..	50	50	49·86	−0·14
54.	,, ..	50	50	49·88	−0·12
	Average				+0·08
55.	III. Frank ..	50	50	50·20	+0·20
56.	,, ..	50	50	50·15	+0·15
57.	,, ..	50	50	50·01	+0·01
58.	,, ..	50	50	50·14	+0·14
59.	,, ..	50	50	51·07	+1·07
60.	,, ..	50	50	51·04	+1·04
	Average				+0·43

(To be continued.)

ON THE DETERMINATION OF MANGANESE IN SPIEGELEISEN AND FERRO-MANGANESE.

By SERGIUS KERN, St. Petersburg.

In a late number of the CHEMICAL NEWS I mentioned that experiments were commenced in order to estimate the manganese in iron alloys by direct ignition of the powdered sample with ammonium chloride. Since then this process has been improved and found by experiment to suit well for technical purposes.

0·5 grm. of the specimen in a state of fine powder is intimately mixed with 6 grms. of ammonium chloride in a high platinum crucible, in which the mass is strongly ignited. Then by the following reaction the iron is converted into ferric chloride, which partly flies away and partly sublimes on the cover of the crucible:—

$$6NH_4Cl + Fe_2 = Fe_2Cl_6 + 6NH_3 + 3H_2.$$

When all the ammonium chloride is decomposed the cover is removed and the sublime crystals of ferric chloride are washed off from the cover by water. Into the crucible a new quantity of ammonium chloride is placed, and the mass is secondly ignited; this operation is repeated till the sublimation of ferric chloride ceases. The residue is dissolved in 25 c.c. of aqua regia, and next evaporated; the dry mass is mixed with a solution of 10 c.c. of hydrochloric acid in 15 c.c. of water, and resulting precipitate of silica is filtered off. The filtrate concentrated on a sand bath is poured into a platinum crucible, in which it is dried, and the resulting mass is next ignited to constancy in weight.

The remaining brownish-black compound is manganomanganic oxide (Mn_3O_4), which is weighed. This compound, as it is known, contains 72·05 per cent of manganese.

Obouchoff Steel Works.

OBSERVATIONS ON SOME XANTHATES. SEPARATION OF NICKEL AND COBALT.

By DR. T. L. PHIPSON.

THE reactions of pure xanthate of potash either in solution in water or in alcohol may become very useful in analytical chemistry. Xanthate of potash is easily prepared by means of alcohol, potash, and bisulphide of carbon; it crystallises easily, and may be kept in the crystalline state unaltered for an indefinite period in well-corked bottles. To use it as a reagent a small quantity is dissolved for the occasion in cold distilled water.

Xanthate of Copper forms a brilliant orange-yellow precipitate when the potash xanthate is added to cupric salts even very acid; it is a salt of protoxide. In neutral copper salts, or those which are slightly alkaline, a basic precipitate of a pale canary yellow is produced. Xanthate of copper is almost completely insoluble in water, slightly soluble in alcohol, and rather more so in sulphide of carbon. Nitric acid attacks and dissolves it easily. When dry it burns like tinder, emitting a garlic odour, and on paper this combustion occurs with a fine purple flame, having a deep border of emerald green. It is quite insoluble in ammonia (the basic salt yields some oxide). In this way xanthate of copper can easily be separated from other xanthates which are, on the contrary, easily soluble in ammonia.

Xanthate of Nickel forms a precipitate of a chocolate brown colour, almost insoluble in water, exceedingly soluble in ammonia.

Xanthate of Cobalt is a dark green precipitate, almost insoluble in ammonia, which circumstance allows it to be easily and rapidly detected in nickel solutions and separated from nickel. With certain precautions this separa-

tion is quantitative. The two metals are precipitated together by xanthate of potash solution, in the cold, added gradually and whilst stirring; the liquid being very slightly acid by hydrochloric acid. The precipitate is allowed to deposit completely, the supernatant liquid decanted off, and the nickel salt taken up by ammonia diluted with its own volume of water, which dissolves it instantaneously, leaving the xanthate of cobalt.

Xanthate of Zinc forms a brilliant white precipitate, very slightly soluble in water, much more so in alcohol, and in sulphide of carbon, extremely soluble in ammonia. The ease with which xanthate of zinc dissolves in ammonia enables us to separate it rapidly and completely from xanthates of *lead*, *copper*, *cobalt* and *indium*, &c.

The solutions of xanthate of nickel and xanthate of zinc in dilute ammonia yield crystals of double ammoniacal salts by exposure to the air. In contact with excess of ammonia these salts (at least that of zinc) appear to undergo decomposition. The nickel salt forms the finest crystals.

The insoluble xanthate, on being dissolved in fuming nitric acid, previously diluted, develops nitrous ether, the odour of which is perceived the moment the solution commences. This proves, according to my view, that the xanthates contain a molecule of ethyl.

PROCEEDINGS OF SOCIETIES

CHEMICAL SOCIETY.

Thursday, June 21, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors, the minutes of the previous meeting were read and confirmed. The PRESIDENT then announced the following grants from the Research Fund of the Society:—Mr. Johnson, £50 for researches on potassium tri-iodide; Dr. Wright, £50 for researches on chemical dynamics; Mr. Neison, £25 for researches on octyl compounds; Mr. C. Williams, £25; and Mr. G. Harrow, £10.

The list of presents to the library was then read by Dr. ARMSTRONG.

The following certificates were read for the first time:—Dr. G. Rühnemann and J. Hadkinson. The following gentlemen were then balloted for and duly elected, the balloting occupying the Society till 9 o'clock:—F. H. T. Allan, H. S. Bell, C. T. V. Buck, J. Y. Buchanan, Dr. A. E. N. Franchimont, J. Gardner, W. Lapraik, G. A. Milne, J. Napier, C. G. Neison, J. L. Nolters, J. H. Poland, I. Scarf, H. Senier, H. G. Stacey, S. G. Thomas, Beeby Thompson, F. W. Toms, A. Watt, W. Webster, jun., J. R. Young.

The SECRETARY then read a paper "*On Diamyl*," by H. GRIMSHAW. This substance was prepared from amyl bromide boiling at 119° to 123°. To 300 grms. of the bromide were gradually added 50 grms. of sodium, and the mixture finally raised to 140° to 150° C. for about six hours. On distilling, diamyl was obtained, which was dried and purified by fractional distillation. When pure it boiled at 168° C. at 751 m.m. By passing dry chlorine into the vapour of the boiling hydrocarbon the chloride was obtained, boiling at 198° to 213°. By heating the chloride in sealed tubes at 160° to 170° for about forty-eight hours with lead acetate and acetic acid an acetate was formed, boiling 198° to 215°, as a colourless mobile liquid of a fruity smell. On mixing this liquid with an excess of caustic potash and a little water, allowing to stand for twenty-four hours, and then boiling for six hours, an inverted condenser being attached, two alcohols were obtained, boiling at 202° to 203° and 211° to 213° respectively. They were light colourless liquids, having an agreeable orange-like odour. These two liquids were mixed, oxidised with bichromate of potash and sulphuric acid, and the acid distilled. The silver salt had the composition $C_2H_3O_2Ag$. Another acid, whose silver salt contained 63·66 per cent Ag, was obtained by the action of bichromate in the cold.

The next paper was read by the SECRETARY "*On the Action at a High Temperature of Certain Volatile Metallic Chlorides on Certain Hydrocarbons*," by WATSON SMITH. The author investigated the action of antimony trichloride and tin tetrachloride on naphthalin, benzene, and toluen, when these substances were severally passed into the state of vapour through red-hot tubes. Benzene was boiled, and the vapours passed through a flask containing boiling antimony trichloride; the mixed vapours then passed through a heated combustion-tube loosely filled with fragments of pumice and porcelain. The products of the reaction were passed into a receiver, connected with which was a Liebig's condenser. The contents of the receiver were returned to the benzene flask, a fresh quantity of trichloride added to the other flask, and the distillation repeated a second and third time. The reaction expected was—

$$6C_6H_6 + 2SbCl_3 = 3\left.\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\right\} + 6HCl.$$

The diphenyl was extracted from the residues, and purified. It melted at 70°, boiled at 243°. The yield of diphenyl by this process was much larger than that obtained by passing the vapour of benzene alone through a red-hot tube (*Proc. Lit. and Phil. Soc. Manchester*, 1871), but was not quite satisfactory, so the action of tetrachloride of tin was tried. 62·4 grms. of benzene were distilled with 52 grms. of the tetrachloride. A very large yield of diphenyl was obtained in one distillation, and very little benzene escaped decomposition. *Toluen and Antimony Trichloride* oils were obtained, boiling 270° to 320°, having very disagreeable odours resembling burnt cheese. *Naphthalin and Antimony Trichloride:* 77 grms. of naphthalin were distilled with 46 grms. trichloride, the mixed vapours being passed through a red-hot tube. The distillation was repeated three times. 15 to 16 grms. of trichloride being added, 37·4 grms. of a crude product were obtained by distillation. This yielded 24·2 grms. of yellow crystalline isodinaphthyl. *Naphthalin and Tin Tetrachloride:* some difficulty was experienced from the blocking of the tubes by the separated carbon, and a special form of apparatus had to be devised. A large yield of isodinaphthyl was obtained, but the process is not so convenient as when antimony trichloride is used. A reddish oil, boiling about 250° to 300°, resembling "red anthracen oil," and some quantity of a citron-yellow powder, were formed. (2.) *Isodinaphthyl Sulpho-Acids and Salts, with certain other Derivatives:* by heating 1 part of naphthalin with 5 parts of concentrated sulphuric acid for four hours to 140° to 150°, treating with barium or lead carbonate, and evaporating, a large yield of the soluble α barium or lead salt was obtained, the difficultly soluble β salts separating out during evaporation. By heating 4 parts of isodinaphthyl with 2 parts of concentrated sulphuric acid to 180° to 190° for five hours a large yield of the β acid was obtained with but little α acid. The α acid was prepared from the barium salt as minute, transparent, yellowish, slightly fluorescent scales, easily soluble in water and ether, slightly in absolute alcohol, insoluble in benzol: the lead salt is easily soluble in water and weak alcohol. The β acid resembles the α acid, but is less soluble; its lead salt is difficultly soluble in water. An oxydinaphthyl or phenyl, a nitro-substitution product, and a cyanogen derivative were prepared, and to some extent examined. (3.) *A New Dinaphthyl:* when naphthalin is submitted to a high temperature, either alone or in the presence of a volatile, easily decomposable chloride, a yellow substance soluble in petroleum spirit is formed, together with isodinaphthyl. In the purification of the crude isodinaphthyl by petroleum spirit a fine red solution was obtained, which by spontaneous evaporation yielded several crops of warty crystals. These were distilled, and

gave a transparent, light yellow, resinous distillate. By fractional crystallisation, and the expenditure of much time and trouble, the author succeeded in separating three substances melting at 75°, 147°, and 250° to 255° respectively. The body melting at 250° to 255° was present in very small quantities in brown transparent plates, and was soluble, with a magnificent blue fluorescence, in benzene or alcohol. The author believes it to be identical with Lossen and Otto's polymeric dinaphthyl (*Ann. Chem. Pharm.*, lxviii., 89, and cxlvii., 170, 181.) The body melting at 147° is an isomeric dinaphthyl, obtained also by Lossen by the action of manganese and sulphuric acid on naphthalin (*Ann. Chem. Pharm.*, lxviii., 71). It boils at 300°. The body melting at 75° is a third dinaphthyl. So three isomeric dinaphthyls are obtained by passing naphthalin, together with antimony trichloride, through a red-hot tube. The one melting at 187° is formed in the largest quantity, next the one melting at 75°, whilst only a small quantity of that melting at 147° is obtained. The three isomers are, then,—

Dinaphthyl. No. 1. Iso-dinaphthyl.
ββ.

Melts at 187°.
Crystallises most readily in beautiful rhombic plates.
Soluble with difficulty in alcohol and ether; with moderate facility in boiling petroleum spirit and benzol.

No. 2. Lossen's.
αα.

Melts at 147° (Smith); 154° (Lossen).
Crystallises readily; form variable, modified by impurities.
Soluble in alcohol and ether; easily in petroleum spirit and benzol.

No. 3.
αβ.

Melts at 75°.
Crystallises with much difficulty, requiring days or weeks.
Very soluble in alcohol, ether, benzol, and petroleum spirit.

In conclusion the author points out the interesting results to be obtained by gentle oxidation, chlorination, &c., of the above bodies, a subject which he intends to take up on an early occasion.

The next paper was "*On the Action of Alkaline Oxalates on the Earthy Carbonates, and of Solutions of Alkaline Carbonates on the Earthy Oxalates*," by Watson Smith. The author having observed that when a solution of ammonium oxalate was brought into contact with chalk or powdered marble an ammoniacal odour at once became apparent, set to work to measure the extent of this and similar reactions. Sodium oxalate in solution on calcium carbonate: if the reaction were complete, 5·3 grms. of sodium carbonate would have been formed; in the cold 1·05 grm. were obtained, = 19·83 per cent; boiling for three hours produced 1·2135 grm., or 22·90 per cent. Sodium carbonate solution on calcium oxalate in the cold: 16·07 per cent; boiled for thirty minutes, 52·34 per cent. Sodium oxalate in excess on powdered marble in the cold: 20·97 per cent; boiling, 26·00 per cent. Sodium carbonate in excess on calcium oxalate: cold, 13·09 per cent; boiling, 78·35 per cent. By treating the same portion of calcium carbonate with successive quantities of sodium oxalate 45·87 per cent of sodium carbonate were obtained, the action gradually ceasing. By treating the same quantity of calcium oxalate with successive portions of sodium carbonate 93·83 per cent was decomposed. Sodium oxalate on strontium carbonate: cold, 7·63 per cent; hot, 7·63 per cent. Sodium carbonate on strontium oxalate: cold, 57·24 per cent; hot, 79·96 per cent. Sodium oxalate on barium carbonate: cold, 4·84 per cent; hot, 4·97. Sodium carbonate on barium oxalate: cold, 73·20; hot, 87·96 per cent. Ammonium oxalate on calcium carbonate: cold, 12·27 per cent; with excess of oxalate, 13·53 per cent; with excess of carbonate, 19·94. Sodium oxalate on lead carbonate: cold, 6·35 per cent; hot, 13·08 per cent. Sodium carbonate on lead oxalate: cold, 81·54 per cent; hot, 90·61 per cent.

The next paper was entitled "*Note on Thallious Platinocyanide*," by R. J. Friswell and A. J. Greenaway. In 1871 one of the authors described a compound of thallious platinocyanide with thallious carbonate—

$$Tl_2PtCy_4,CO_3Tl_2,$$

crystallising in dark red crystals reflecting a green metallic light; by treatment with nitric acid colourless crystals were obtained having the formula—Tl_2PtCy_4. Carstanjen, however (*Journ. Pract. Chem.*, 102, p. 144, *Watts's Dict.*, Supp. ii., 1153), states that he obtained thallious platinocyanide in blood-red needles, having a metallic green lustre by reflected light. As this is not in accordance with the above statement the authors have re-investigated the subject with great care. Hydroplatinocyanic acid was prepared, and neutralised with an equivalent quantity of thallious carbonate—

$$Tl_2CO_3 + H_2PtCy_4 = Tl_2PtCy_4 + CO_2 + OH_2,$$

a colourless neutral salt was obtained. On adding to it a fresh portion of the acid, twice the above amount of thallious carbonate, the dark red salt already described was obtained. Baric platinocyanide was also decomposed by thallious sulphate; the resulting crystals were quite colourless. The authors give the following analysis of the colourless thallious platinocyanide—

Pt, 28·09; C, 6·60 and 6·78; N, 7·76 and 7·91;

theory requires Pt, 27·82; C, 6·76; N, 7·89. These numbers show conclusively that the salt described by Carstanjen (especially as he gives no analysis) was really the double carbonate, and that thallious platinocyanide is a colourless compound.

The next paper was "*On Crystallised Barium Silicate*," by E. W. Prevost. Pisani (*Comptes Rendus*, lxxxiii., 1056.) states that he has found the above substance attached to the sides of bottles in which barium hydrate solution had remained for several years; the author has obtained crystals formed under the same conditions, and having the same measurements, but containing only 0·78 per cent silica; they consist of barium hydrate, and contain 45·4 per cent water and 72·5 per cent barium; theory requires 45·6 per cent and 73·09 per cent.

The next paper was "*A Note on Anethol and its Homologues*," by W. H. Perkin. The author mentioned that he had already (*Chem. Soc. Journ.*, 1877, 409-414) stated that methyl-paroxy-phenyl-acrylic, methyl-paroxy-phenyl-crotonic, and methyl-paroxy-benzyl-angelic acids, when heated, split up into carbonic acid and oily products; that from methyl-paroxy-phenyl-crotonic acid being supposed to be anethol, and those from the other acids homologues of that substance. Further experiments on this subject have since been made. On boiling *methyl-paroxy-phenyl-acrylic acid* in a bulb-tube provided with a side delivery tube, the heat being so moderated that a thermometer placed in the upper part of the tube does not rise above 220-240°, an oil gradually distils over, but after a time ceases, leaving a good deal of a dark coloured residue in the retort. The oil after purification gave numbers on analysis corresponding with the formula—

$$C_9H_{10}O = C_6H_4\begin{cases}(OCH_3)\\(CHCH_2)\end{cases}$$

When cooled in a freezing mixture it solidifies to a crystaline mass, having an odour and taste like fennel. When heated in a retort it rapidly changes, and before much has distilled over the principal part of it thickens, and on cooling forms a transparent nearly solid product; when oxidised it yields apparently anisic acid. *Methyl-paroxy-phenyl-crotonic acid* when distilled in the same manner as the above also yields an oil, but leaves less residue in the retort. This oil does not change much on distillation, and when fractionated begins to boil at 220°

the principal quantity, however, comes over between 230°-240°, leaving a little high boiling residue in the retort. Both of these fractions, when cooled in a freezing mixture, solidify, but the higher fraction freezes most readily and becomes harder; on pressing these products between bibulous paper, white crystals were obtained, which were purified by crystallisation from alcohol. This substance has the composition, melting and boiling points, as well as the taste, odour and appearance, of anethol. This indicates that the constitution of the C_3H_5 group in anethol has the constitution—

$$CH=CH-CH_3,$$

as will be seen, thus :—

$$\underbrace{C_6H_4(OCH_3)CH,CH,CH_2,COOH}_{\text{Methyl-paroxy-phenyl-crotonic acid.}} =$$

$$= \underbrace{C_6H_4\begin{cases}OCH_3)\\(CH,CH,CH_3)\end{cases}}_{\text{Anethol.}} + CO_2$$

The author proposes to examine this body more critically when a sufficient quantity has been prepared. Methyl-paroxy-phenyl-angelic acid also when carefully distilled yields a crystalline anethol-like body as already mentioned in the paper previously referred to, but although there can be no doubt about its formula, it has not yet been obtained sufficiently pure for analysis.

Dr. ARMSTRONG thought that it was not at all proved that the C_3H_5 group had the constitution—

$$CH=CH-CH_3,$$

as isomeric changes might occur in the treating, and from other considerations it seemed much more probable that its constitution was $CH_2=CH-CH_2$.

The next paper was entitled "*Note on Persulphocyanic Acid*," by R. W. ATKINSON, Japan. The author commences by stating that the constitution of the above body is still uncertain, and points out the decompositions which must be indicated by its formula. The substance was prepared and purified by re-crystallisation from boiling water; its properties are described, also the precipitates produced by argentic nitrate, mercurous nitrate, and solution of iodine. Numerous experiments were made by adding varying quantities of argentic nitrate to the acid dissolved in alcohol, and evidence of the existence of $Ag_2C_2N_2S_3$ and $AgHC_2N_2S_3$ was obtained. When the yellow argentic persulphocyanate is boiled with water it quickly decomposes with effervescence, a heavy black precipitate being produced; attempts were made to determine the composition of this precipitate, but the results obtained vary widely. The general nature of the reaction is probably—

$$Ag_2C_2N_2S_3+3AgNO_3 = \\ = 2Ag_2S+AgCNS+CO_2+N_2O_4+N_2O_3$$

The mercurous salt is not apparently decomposed by boiling. In conclusion, the author points out the resemblance between the (probably correct) formula proposed by Glutz (*Deut. Chem. Ges.*, iii., 343) with that of parabanic acid.

The next paper was "*On the Oxidation Products of the Aloins*," by A. TILDEN, D.Sc. (Lond.) When nataloin is digested with 10 per cent. solution of bichromate of potassium, acidified with sulphuric acid, carbonic and acetic acids were alone obtained. If, however, barbatoin be similarly treated only a small quantity of acetic acid is formed, but a brown precipitate is deposited, this on analysis gave—C, 63·3 per cent; H, 3·2 per cent. The corresponding body from socaloin purified by solution in acetic ether gave—C, 63·8 per cent; H, 3·4 per cent. On treating in a rapid current of carbonic anhydride a yellow pulverulent sublimate, containing a few orange needles, was obtained. This re-crystallised from acetic ether gave C, 61·6 per cent; H, 3·4 per cent. The substances from socaloin and barbaloin are identical, and the author proposes the name of aloxanthin. This substance forms an orange granular powder, melting imperfectly at 260°-265°, subliming slowly at the same temperature in orange scales and dust. It is slightly soluble in water, very slightly in bisulphide of carbon, chloroform, alcohol, and ether. Its best solvents are ethyl acetate and glacial acetic acid. In caustic soda it dissolves to a bright cherry-red solution without absorption bands. Heated with zinc dust, a hydrocarbon, having a greenish fluorescence is obtained, melting at 203°-205°. This consists principally of methyl-anthracen. Aloxanthin fused with caustic potash forms an indigo blue mass; aloxanthin does not combine with merdants. Its formula is probably $C_{15}H_{10}O_6$, being a methyl-tetroxy-anthraquinon. Three analyses of the purest sample gave—C, 62·9; H, 3·3. Theory requires C, 62·9; H, 3·3 per cent. An acetyl compound was formed. Aloxanthin treated with fuming nitric acid in the cold yields a yellow nitro-acid, having the properties of aloetic acid.

The Society then adjourned over the vacation to Thursday, Nov. 1st.

PHYSICAL SOCIETY.

June 23rd, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

PROF. W. GRYLLS ADAMS exhibited and described a very complete form of optical bench, which, in addition to being provided with all the improvements introduced by Prof. Clifton, carries an arm which can be set at any angle to it, and is provided with appliances for studying a beam of light or radiant heat when it deviates from the main axis of the instrument. At the base of a pillar firmly clamped in any position in the manner adopted by Prof. Clifton, is fixed a horizontal graduated circle, and a vernier attached to a counterpoised arm, which rotates round the axis of this pillar, renders it possible to determine the angle made by the arm with the bench to one minute. At the upper extremity of the pillar is a steel pivot to which various appendages may be clamped, and immediately below this is a second graduated circle by which to determine the angular position of whatever is supported by the pillar. Mirrors, metallic surfaces, prisms, &c., may be placed on this pillar for the reflection, refraction, diffusion, or polarisation of heat and light. For radiant heat the rotating arm carries a line, thermo-electric pile, and a table on which absorbing media may be placed. Prof. Adams illustrated the use of the instrument by projecting on to a screen the interference bands obtained when a beam of light, after reflection from the two surfaces of a thick plate of glass, is again reflected from the two surfaces of a similar plate placed very nearly but not quite parallel to the first. A compensator consisting of two plates of glass of equal thickness is also added between the two thick plates, and an ingenious arrangement renders it possible to incline the glasses at any angle to one another, and to move them either independently or together. He also showed the delicate adjustment of which this compensator is susceptible and the effect produced in the positions of the bands when the rays from the two surfaces of the first plate traverse air of different densities before falling on the second. The adjustment of this latter was facilitated by fine screws supplemented by springs, which rendered it possible to give a slight movement to the plate in any direction by combining a motion of translation of the plate parallel to its reflecting faces with a motion of rotation about a vertical or horizontal axis.

Mr. F. D. BROWN exhibited an apparatus he has arranged in which to compare thermometers, and which is also applicable to other cases requiring a limited space to be retained at a perfectly uniform elevated temperature. From a

brass hemispherical boiler rises a tube of the same metal, 2 inches in diameter and about 2 feet long; the steam, after ascending through it, descends a metallic jacket surrounding it, whence it passes into a U-shaped condenser, and from this it is returned to the boiler. The upper end of the condenser is in connection with a large air-tight vessel forming the base of the apparatus, and in which any required degree of exhaustion can be maintained by the use of Lothar Meyer's form of pump. The thermometers are placed in tubes containing liquid, which pass within the wide brass tube at its upper end, and by varying the nature of the liquid in the boiler and the pressure to which it is subjected the boiling-point can be retained constant at any required temperature.

Dr. Guthrie and Mr. Akroyd communicated a paper on "*Electrical Selection*." When a metal or other body is rubbed against some non-conducting substance like caoutchouc, electricity is developed, and the track of the metal, although invisible, may be readily made evident by sprinkling on the caoutchouc a mixture of red-lead and sulphur. This sieving, as is well known, imparts negative electricity to the sulphur and positive to the red-lead; hence, by a kind of electrical selection, that particular ingredient of the mixture is drawn to the metal track which possesses the opposite kind of electricity. Iron, for example, when rubbed against caoutchouc generates negative electricity, and, after sprinkling the powder, the iron track is revealed by the marked collection thereon of red-lead. A list of mixtures was given which may be used instead of the above, and it was shown that electrical selection may prove of use (1) in making an electrical diagnosis of the metals, (2) in certain experiments where the quadrant electrometer is objectionable, and (3) in teaching, where this instrument is often unavailable on account of its cost.

An adjourned Special General Meeting of the Society was then held, after which the meetings were adjourned until November next.

NOTICES OF BOOKS.

A Treatise on the Law relating to the Pollution and Obstruction of Water-courses, together with a Brief Summary of the Various Sources of Rivers Pollution. By Clement Higgins, M.A., F.C.S., Barrister-at-Law. London: Stevens and Haynes.

The pollution of rivers has its legal as well as its chemical aspect. In the work before us the part of the question is dealt with in a full and comprehensive manner, chemical considerations playing a mere secondary part. The book consists of two portions; the former being devoted to a consideration of the "Rivers Pollution Prevention Act" of 1876, and the latter to "Riparian Rights and their Protection."

In the former of these divisions an inquiry is instituted as to the meaning of the word "polluting," which has not been defined by the framers of the Act. As a matter of course, our old acquaintances, the "Recommendations" of the late Rivers Pollution Commissioners, crop up, and are weighed in the balance with a degree of impartiality no less rare than praiseworthy. One important omission, however, must be noted, viz., the absence in these Recommendations of any special prohibition of the admission of chromium compounds into a water-course. Save arsenic, on the one hand, and calcium, magnesium, potassium, and sodium on the other, all metals, poisonous or harmless, are placed on a level. Mr. Higgins also forgets that under the terms "organic carbon" and "organic nitrogen" are included substances respectively dissimilar in their susceptibility to decomposition and in the nature of the products formed.

To the critique that the "Recommendations" entirely disregard the proportion between the bulk of the polluting liquid and of the river into which it flows, we find appended the following curious remark:—"To this objection it may be answered that to do so would be practically impossible, as the bulk both of the polluting liquids and of the river are continually changing." To this we beg to demur altogether: the amount of sewage from a town, of refuse water from a dye- or print-works, &c., is substantially the same one year as another. Nor do we find such rivers as the Thames, the Clyde, or even the Aire, dwindle occasionally into mere brooks like the Soar, the Croal, or the Hebble. The question is, to what extent does an inflowing sewer affect the quality of the stream? Any code based on the lines of the Recommendations opens the door to evasions without end. As to the eminent chemists whose names are mentioned as having pronounced the "Recommendations" practicable, we cannot help asking how many of them have made the pollution of rivers or the treatment of sewage the object of special and independent investigation? The suggestions of Mr. Crookes that "the river itself should be the standard of purity," and that "no liquid should be allowed to be sent into a river if the liquid contains a greater percentage of impurity than the river itself," are declared "simple and practicable." It is further added that they would ultimately prove so effectual that they may be safely followed by County-court Judges in their decisions under the Act.

The remarks on the pollutions from paraffin-oil works are perfectly correct: neither by filtration, irrigation, or precipitation can these nuisances be dealt with, and their total exclusion from sewers should be insisted upon. The same rule applies to certain liquid refuse from india-rubber works. The introduction into the sewers of the liquid obtained by "ungumming" silks is a grievous waste, since its manurial value is very high.

Mr. Higgins reminds his readers that it is not the duty of the courts to advise defendants in what manner they may comply with the terms of an injunction, and that an allegation that a satisfactory mode of deodorising the sewage has not been selected will not justify failure in obeying the decree.

Proof that the best practicable and available means have been adopted for rendering harmless the sewage matter falling into a stream may be given either by the production of a certificate of an Inspector of the Local Government Board, "*which is conclusive*," or by the production of scientific evidence, the conclusiveness of which seems to be an open question. We presume, therefore, that the Inspectors of the Local Government Board must be something more than mere men of science, and specially invested with infallibility. It is the more satisfactory to know this, as from certain recent disclosures the Board appear inclined to patronise cheap chemistry, a very fallacious article.

So far as we can, without presumption, venture to decide on the value of this book, we consider it a most important and welcome addition to the literature of what is generally known as the sewage question. We presume that few municipal authorities, sanitary boards, owners of land on the banks of rivers, &c., will neglect the opportunity now offered them of obtaining a clear view of the law of river-pollution.

Introduction to the Study of Chemical Philosophy. The Principles of Theoretical and Systematic Chemistry. By W. A. Tilden, D.Sc., F.C.S. London: Longmans, Green, & Co.

This work, which forms a member of the useful series of "Text-books of Science" issued by Messrs. Longmans, may be said to take the place once occupied by Daubeny on the Atomic Theory, embodying a general view of

chemical theory as it exists at the present time. The author treats successively of the constitution of matter, of fusion and solution, of liquid diffusion and dialysis, of evaporation, and ebullition, of gases, of the diffusion of dialysis of gases and their relation to temperature, and of spectra. He next proceeds to the consideration of elements and compounds, the laws of chemical combination, the the clasification of rections, the distinction between compounds and mere mixtures, nomenclature, the condition of chemical change, theories regarding the nature of chemical attraction, and combustion. In a third section the student is introduced to equivalents and atomic weights, molecular weights and formulæ dissociation, types, atomicity, unsaturated compounds, and isomerism. The fourth and fifth sections are respectively devoted to the classification of the elements and of compounds. The simple bodies he divides into three groups, oxigenic or non-metallic, metalloids or imperfect metals, and true metals or basigenic elements. The second of these classes includes hydrogen, but we are glad to find that the author protests against the too common though illogical practice of giving the name metalloid to such bodies as oxygen, chlorine or fluorine. Silicon he leaves with boron and carbon in the first class.

At the end of each section are found appropriate exercises. The authors own method in teaching chemistry is to get "the more advanced classes to read it by small portions at a time, and to work out all the exercises." Such a course of study, however, he fully admits can be profitably undertaken only as the sequel to a series of of experimental lessons. The work may be pronounced a fair, clear, and sufficiently comprehensive view of chemical theories as at present generally accepted, and as such it may be recommended to all students who have already made themselves sufficiently familiar with the facts of the science.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 21, May 21, 1877.

Gay-Lussac's Law of Volumes.—M. H. Sainte-Claire Deville.—Reserved for insertion in full.

Report on a Memoir by M. Stanislas Meunier entitled "Composition and Origin of the Diamond-Sand of Toit's Pan in South Africa.—MM. Des Cloizeaux and Daubrée.—The authors, whilst admitting that the diamond-rock has been raised up from below, do not consider that its elevation is due to volcanic action. The authors think that each of the rocks found filling the pans has been torn from a distinct bed, and conveyed separately to the place where they are now found in mixture. Hence these sands belong to the same class as the granitic sands found interposed among stratified deposits.

Use of Oxygen at High Pressure in Physiological Investigations.—M. P. Bert.—The author has shown that oxygen at high pressure rapidly destroys all living beings and of all anatomical elements. All those phenomena known as fermentation, where the action depends on the presence of living beings, such as acetification, putrefaction, &c., are completely arrested even by the transitory action of compressed oxygen, whilst fermentations due to a dissolved matter (diastase, emulsine, &c.) perfectly resist the influence. He has applied this action of compressed oxygen as a means of physiological investigation. He finds that the ripening of fruits is arrested by exposure to compressed oxygen, and is hence due to a cellular evolution. The poison of the scorpion, whether liquid or dried and re-dissolved in water, entirely resists the action of compressed oxygen. Such poisons owe their action to chemical compounds comparable to the vegetable alkaloids. Fresh vaccine matter submitted for more than a week to oxygen at a pressure equal to about 50 atmospheres retained its virtue. The matter of glanders, after similar treatment, rapidly killed horses inoculated therewith. Hence these kinds of virus do not owe their properties to living beings or living cellules. Carbuncular blood, also, after exposure to compressed oxygen, though freed from bacteria, nevertheless retained all its dangerous properties.

Use of Rotatory Discs for the Study of Sensations of Colour.—M. A. Rosenstiehl.—Reserved for insertion in full.

Oxalic Acid as a Characteriser for the Poly-atomic Alcohols, and on the Chemical Functions of Inosite.—M. Lorin.—The author's experiments with dehydrated oxalic acid give more extension to an easy and industrial preparation of formic acid in a high state of purity, and almost at its maximum degree of concentration, and furnish a new characteristic of the poly-atomic alcohols, among which must rank inosite.

Decomposition of Hydrochlorate of Trimethylamin by Heat.—M. Camille Vincent.—This compound may serve for the easy and abundant preparation, not merely of mono-methylamin, but also of chloride of methyl, yielding hydrochlorate of ammonia as a by-product. This decomposition may be utilised for causing the chloride of methyl to react at a high temperature, and in the nascent state, upon various bodies, and especially upon aniline. If we heat a mixture of hydrochlorate of trimethylamin and hydrochlorate of aniline we obtain methyl-aniline, which distils over, and which only requires to be washed with water and rectified. If thus prepared it is free from all traces of aniline. The hydrochlorate of trimethylamin, which is now obtained on the large scale, may thus be judiciously utilised for the preparation of ammoniacal products and of pure chloride of methyl, which latter may serve either in the manufacture of methylated aniline colours, or in the preparation of pure methylic alcohol.

Spectrum of the Electric Spark in a Compressed Gas.—M. A. Cazin.—The electric spark in a gas is analogous to the ordinary flame of a hydrocarbon. In each of these luminous sources there are gaseous particles which produce a spectrum of lines, and solid or liquid particles which produce a continuous spectrum. These are derived in case of the spark from the electrodes and the sides of the vessel when very near. When the pressure is increased these particles are more abundant, their continuous spectrum becomes more brilliant, and, finally, causes the disappearance of the linear spectrum of the gaseous particles. It is in the flash of fire that things take place thus; the paler luminous halo or aureola is formed of gaseous particles whose linear spectrum is more or less visible; it is to the entire spark what the blue base of the flame of a candle is to the entire flame. At ordinary pressures, in nitrogen, the spark is pale and furrowed with small flashes of fire. We see in the spectroscope the grooves ascribed to nitrogen, and in their intervals the characteristic lines of this gas. On compressing we see the grooves disappear little by little, whilst the continuous ground of the spectrum becomes more brilliant. When the pressure exceeds two atmospheres there are only six lines of nitrogen from the orange to the blue, and five diffused bands beyond. At 10 atmospheres there only remain the two nitrogen lines $\lambda = 567$ and $\lambda' = 500$, and then a very brilliant line in the violet $\lambda'' = 424$ which first appears at 5 atmospheres. The sodium line is very distinct, whilst it is not to be distinguished at ordinary pressures. About 15 atmospheres the spark becomes dazzling; upon the continuous spectrum are seen the four lines above mentioned, and certain brilliant points due to platinum. In air compressed above

30 atmospheres the spark produces intense reddish vapours, and the spectrum showed the absorption spectrum of hyponitric acid.

Certain New Forms of the Radiometer.—Mr. W. Crookes.—The contents of this paper are known to English readers.

Thermo-Chemical Researches on Aniline and certain other Bodies of the same Group.—M. W. Longuinine.—It appears from these experiments that aniline is a feebler base than ammonia, which, in the cold, displaces it entirely, or nearly so. Toluydin is not displaced by aniline in notable quantity from its combination with hydrochloric acid.

Nitrates of Bismuth.—M. Yvon.—The acid nitrate of bismuth however crystallised presents the composition $BiO_3,3NO_5,11HO$. The sub-nitrate was obtained by decomposing the acid salt with 16 parts of water. Both the first precipitate and that from the 12th, 13th, and 14th washings showed the constant composition—

$$5BiO_3NO_56BiO_3HO.$$

The sub-nitrate obtained in regular brilliant oblique prisms with rhombo-hedral bases, corresponds with the formula, $BiO_3NO_5{\frac{1}{2}}HO$.

Properties of Resorcin and its Molecular Volumes.—M. L. Calderon.—An attempt to calculate the molecular volume of dissolved resorcin.

No. 22, May 28, 1877.

Gay-Lussac's Law of Volumes.—M. A. Würtz.

Reply to a Note by M. Würtz relating to the Law of Avogadro and the Atomic Theory.—M. Berthelot.—These two papers, which will be inserted in full if possible, are contributions to the dispute now going on between MM. Würtz and Sainte-Claire Deville.

Researches on the Substituted Eugenols.—M. A. Cahours.—This paper contains a description of ethyleneugenol, a body formed during the reciprocal action of dibromide of ethylen and potassic eugenol, and of its immediately higher homologue propylen-eugenol.

Thermic Researches on the Substituted Anilines. M. W. Louguinine.—The compounds examined are the three chlorated anilines (ortho, meta, and para), paranitro aniline. The author draws the following conclusions:—The heat liberated in the combination of the aniline group studied is diminished in a striking manner when one atom of hydrogen is replaced by one electro-negative atom or group; the decrease is especially considerable for the nitro-derivative. In the same substitution there is a diminution of the resistance of the salt formed with HCl to the action of an excess of water. The toluidin (para) dissolved liberates in its combinations with acids rather more heat than aniline, and its salts are more stable under the influence of an excess of water. In the anhydrous state the results are not comparable, the aniline being liquid and the paratoluidin solid. Several of the derived anilines give rise to the same difficulty. The various bases, isomers of mono-chlor-aniline, do not liberate the same quantities of heat on combining with acids. When all is dissolved the para base liberates the most.

Electrolysis of Ordinary Pyro-tartaric Acid.—MM. E. Reboul and E. Bourgoin.—Ordinary pyro-tartaric acid is very stable and undergoes electrolysis after the manner of a mineral acid. It differs in this respect from succinic acid, whose tolerably alkaline solution is easily decomposed into ethylen and carbonic acid. It may rank with the phthalic and camphoric acid.

Researches on the Synthesis of Acids of the Series $C_nH_{2n-2}O_2$ and $C_nH_{2n-4}O_4$.—E. Reboul.—Not adapted for abstraction.

Decomposition of Carbonic Acid in the Solar Spectrum by the Green Parts of Plants.—M. C. Timiriazeff.—In the reduction of carbonic acid by the green parts of plants the solar rays act in the ratio of their energy and of the elective absorption by chlorophyll.

Reimann's Färber Zeitung, No. 18, 1877.

At a meeting of the Berlin Dyer's Association, held on May 4th, a paper was read on the importance of technical schools, and an interesting discussion took place, the prevalent opinion being that the branches of trade concerned ought not to depend upon the aid of Government, but take the matter into their own hands.

An aqueous solution of eosin is recommended as a red ink.

No. 19, 1877.

The editor calls attention to the fact that tissues, especially woollen, which have been for a long time exposed to air and light, acquire a stronger affinity for colouring matters than portions of the same material which have been kept in the dark. This circumstance often renders the production of a level shade in garment dyeing simply impossible, those parts upon which the light has chiefly fallen always taking the dye more readily, and coming up as dark stripes or spots.

Les Mondes, Revue Hebdomadaire des Sciences, No. 3, May 17, 1877.

According to the French *Nature* Druidical practices are not entirely extinct in Bretagne, and the clergy are consequently very anxious to destroy the menhirs.

Father Secchi is said to have invented a new electric sismograph in which paper blackened with smoke is set in motion, and which indicates the direction, number, intensity, and duration of shocks, and many other details.

No. 4, May 24, 1877.

In an article on the "Extravagances of Science," levelled at the *Revue Scientifique*, Professor Haeckel is designated as the "leader of atheistic science beyond the Rhine."

The ordinary phosphate of soda is strongly recommended as a remedy for debility, and especially for pulmonary consumption.

No. 6, June 7, 1877.

This issue contains no original chemical matter.

MISCELLANEOUS.

The Emperor of Brazil.—On Saturday morning last His Imperial Majesty, the Emperor of Brazil, honoured Mr. Crookes, F.R.S., with a visit, at his house in Mornington Road, where he remained some time examining the various forms of Radiometers, and witnessing some experiments on Repulsion resulting from Radiation.

Sanitary Institute of Great Britain.—A meeting of the Institute will be held in the Lecture Theatre of the Royal Institution on Thursday, July 5, at 4 o'clock p.m. The Duke of Northumberland, K.G., D.C.L., President, in the chair. Dr. B. W. Richardson, F.R.S., will deliver a Lecture on "The Future of Sanitary Science—in Relation to Political, Medical, and Social Progress."

Trade Marks.—A fortnightly journal specially devoted to all matters connected with British, Colonial, and Foreign Trade Marks, and for the promotion of a complete system of International Registration, is announced to appear on July 2, with the title "Trade Marks."

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

MAY, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Anhydride. Sulphuric	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·001	0·007	0·135	0·049	20·50	8·550	0·460	0·80	1·670	13·2	3·3
West Middlesex	Slightly turbid	0·000	0·007	0·150	0·059	20·20	8·540	0·460	0·87	1·670	13·2	4·2
Southwark and Vauxhall	Clear	0·001	0·008	0·150	0·052	19·60	8·490	0·460	0·87	1·680	13·2	3·3
Chelsea	Clear	0·000	0·007	0·135	0·052	20·10	8·210	0·500	0·94	1·740	13·2	3·3
Lambeth	Slightly turbid	0·000	0·008	0·180	0·053	21·00	8·600	0·610	0·87	1·006	13·7	3·7
Other Companies.												
Kent	Clear	0·000	0·002	0·420	0·003	31·00	12·320	0·610	1·59	4·530	19·4	6·5
New River	Clear	0·000	0·006	0·138	0·036	19·40	8·160	0·500	0·87	1·800	12·6	3·3
East London	Clear	0·000	0·007	0·180	0·028	18·80	8·660	0·500	1·01	1·930	11·6	3·3

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

NOTES AND QUERIES.

Orange Sulphide of Antimony.—In what manner is the "orange red sulphide of antimony" as used by india-rubber manufacturers obtained from the "black" commercial sulphide of antimony?—J. M CROSSAN.

TO CORRESPONDENTS.

C. M.—Apply to Messrs. Johnson and Matthey, Hatton Garden, E.C.

ERRATA.—Page 257, col. 1, line 44 from top, page 258, col. 1, line 13 from top, and col. 2, line 23 from top, *for* "heated" *read* "treated."

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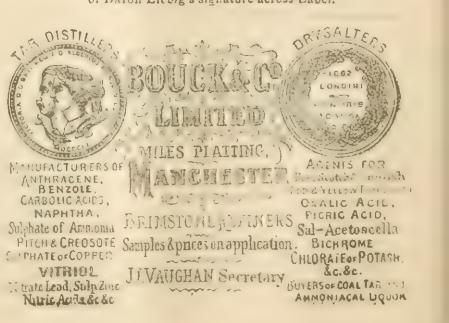

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ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from vol. xxxv., p. 268.)

163. These experiments had all been tried with surfaces made of pith, a very bad conductor of heat. It became of interest to ascertain what would be the action of a radiometer the fly of which was made of a good conductor, such as a metal. Experiments already recorded show that metals behave generally like pith. This has been proved in the case of magnesium (99, 100), aluminium (122), silver and bismuth (63), copper (64), brass (37—40, 61), and platinum (55, 62, 113, 114, 115); but none of these experiments have been tried under the different conditions to which I have lately submitted the radiometers.

164. I selected thin rolled brass as the material wherewith to make the fly of a radiometer. The parts were all fastened together with hard solder, and no cement or organic matter was used, so that if necessary the radiometer could be submitted to a high temperature without injury. In general appearance when finished it resembles the instrument shown in fig. 6. The moving portion weighed 13·1 grains. One side of the disks was silvered and polished, the other side being coated with lampblack. The apparatus was exhausted with a charcoal reservoir attached. When exhausted it proved to be very sensitive, considering its weight, a candle 1½ inch from the bulb causing it to revolve about once a second, the black surface being repelled in the normal manner.

165. The apparatus, standing motionless in a rather dark cold room, was covered with a warm glass shade. It immediately commenced to revolve the negative way, viz., silver side repelled, but very slowly.

A few drops of ether poured on the bulb caused the arms to move rather rapidly the normal way. A hot shade put over whilst it was thus moving caused it to stop, and then begin moving the negative way.

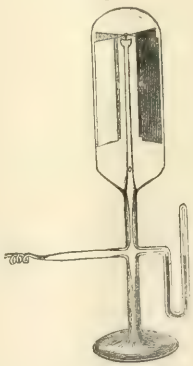
A small non-luminous gas-flame was held vertically beneath the apparatus, so that hot air should ascend and wrap round the bulb on all sides. The arms now revolved the negative way.

166. The brass radiometer being somewhat heavy, one was made of aluminium, of the shape represented in fig. 9. The surfaces were made large, and the whole moving parts were hard-soldered together. A siphon-gauge was attached, and the apparatus was connected direct on to the pump by a spiral, no charcoal-tube being used. One side of the wings was bright aluminium and the other was lampblacked. When exhausted the fly revolved very quickly to a candle a few inches off, the black being repelled.

167. On removing the candle a remarkable phenomenon was observed. The arms stopped and immediately commenced revolving the negative way, keeping up rotation for more than ten minutes, and being little inferior in speed to what it was when the candle shone on it.

The whole of the bulb was heated with a Bunsen burner; whilst it was getting hot the aluminium arms revolved rapidly in the normal direction; but as soon as the source of heat was removed and cooling commenced, negative rotation set up, and continued with great energy till the whole thing was cold. It appeared as if the negative movement during cooling was equal in amount to the positive movement as it was being heated.

Fig. 9.



168. The very sensitive pith radiometer used in experiments 152 *et seq.* was now experimented with. A little ether was dropped on the bulb as it was standing still in a faint light. The evaporation of the ether caused a chilling of the instrument and a rapid abstraction of heat from the fly. It commenced to move in the positive direction, and increased quickly in speed until it revolved at a rate of one in four seconds. This movement kept

* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

up for several minutes, and as it slackened it could at any time be revived by a few drops of ether on the bulb.

When in rapid positive movement, produced in the above manner, a hot glass shade (161, 163) was placed over the radiometer. The movement slackened, the arms quickly came to rest, and then immediately revolved in the negative direction, acquiring a speed of about two revolutions a minute, and keeping up this negative movement for more than ten minutes.

169. The radiometer was again set in rapid positive rotation by dropping ether on the top of the bulb. I applied the tip of one finger to the side of the bulb for ten seconds. The rotation stopped, and I could not start it again for some minutes, although I dropped ether on the bulb, several times in the interval.

When the radiometer had once more acquired the temperature of the air, I dropped ether on the bulb, not in the centre, but so that the ether wetted only half of the bulb. The arm which was nearest to the part most wetted by the ether rushed towards that part and remained, as it were, fixed opposite to it, refusing to move away, although I tried to equalise the temperature by dropping ether on the other parts of the bulb, and to drive it round by bringing a candle near. Not until the candle came within 6 inches of the bulb did the arms begin to rotate, which they then did with a rush, as if suddenly relieved from a state of tension.

170. These results appear at first sight anomalous. I think, however, they admit of an explanation which is in keeping with the facts, if I may make one supposition. The great difference between a lampblacked and a white surface is only an optical one. Pith reflects a considerable amount of light, and lampblack absorbs a large quantity of light, but it is unsafe to carry the analogy into the ultra-red region of the spectrum. We know of many white powders, optically identical, which in their thermic relations are as wide apart as pith and lampblack (*e. g.*, powdered alum and powdered rock-salt); and it is therefore reasonable to suppose that other substances may exist which, whilst they are very different to the eye, may have the same action on dark radiant heat. We may also fairly assume that a substance may exert a considerable selection on the rays which it absorbs and reflects—that, in fact, there may be, in the ultra-red region of the spectrum, *thermic* colours, as in the visible spectrum we have *optical* colours; so that whilst two substances may absorb to the same extent heat-rays of one refrangibility, they may be quite different in their actions on heat-rays of another refrangibility. These suppositions are not only reasonable but very probable: let us see how they account for the facts. Light falls on the black and white surfaces of a radiometer, or other similar instrument. That which falls on the white surface is nearly all reflected back again. Were the surface perfectly white *all* the force which went into the bulb would be reflected out again; the incident ray would contain in itself a certain amount of potential work; but as the emergent beam would come out with no loss of intensity, no work could have been done on the reflecting surface. In practice this does not quite hold good. Pith is not a perfect reflector, some light stops behind, that which comes from it is not quite equal to that which it receives, and the balance makes itself evident by causing the pith to move to a slight extent.

171. But in the case of light falling on the lampblacked surface the result is very different. Here, practically, the whole of the light is quenched by the lampblack. Force is poured into the bulb, but none comes out. What, then, becomes of it? It is changed into motion, and becomes evident in the strong repulsion which is exerted on the black surface.

This I think is clear in the case of light. We can see that there is an enormous difference in the absorbing powers of white and black pith for light, and we can also see that there is an equally marked difference between the motive power which light exerts on them. But with the heat from boiling water or from a hot copper ball our eyes cannot tell us whether the same difference obtains or not, and we must use other and less direct means of finding out what takes place.

Let me direct attention to the experiments described in paragraphs 128 and 144. Here red-hot copper was seen to repel the black surface with violence, and the white surface only moderately. As the copper ball cooled, the repulsion on each surface became more nearly equal. At 400° C. the differential action was decided, though faint. At 300° C. the black surface was still repelled slightly more than the white surface, but at 250° C. down to 100° C. the repellent action of the radiant heat was the same on the white as on the black surface. The two surfaces were then *thermically* of the same colour.

The fact that the work done on each surface was equal, is, I think, proof that the absorption of the incident rays was equal.

(To be continued.)

ON PUTRESCENT ORGANIC MATTER IN POTABLE WATER.*

By GUSTAV BISCHOF.

It is indeed fortunate that the smell and taste are generally extremely sensitive indicators of putrefaction in articles of food. This does not, however, apply to drinking water, which may be largely polluted by putrescent organic impurities without causing any suspicion to our senses. And yet the question of the wholesomeness of water hinges mainly upon the presence or absence of such putrescent matters, as they themselves are the cause of derangements of the human system. Most serious, however, are the consequences when those low forms of organic life, which in all probability form the specific poison of cholera, typhoid fever, and other diseases, gain admission to drinking water polluted by putrescent matter.

A number of observations point to the conclusion that these organisms, or their germs, are not infectious as long as surrounded by *fresh* organic matter, but as soon as fermentation sets in they show their poisonous virulence. Thus it has been observed that the discharges of cholera and typhoid patients are not infectious as long as they are fresh, but by putresence their poisonous character is developed.

Chemical analysis is incapable of discriminating between living or dead, fresh or putrescent organic matters. The miscroscope reveals their nature more fully; but it is nevertheless frequently a matter of great difficulty to decide as to the existence or non-existence of *bacteria* of putrefaction, or their germs, in water. It thus appeared to me that this information might, in some cases at least, be gained with greater certainty by an indirect method.

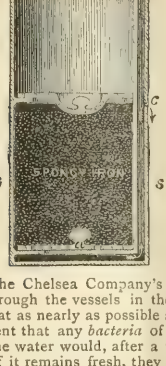
If we want to determine whether a gas be carbonic anhydride, we pass it through potash bulbs, and see whether these increase in weight. Similarly the presence or absence of putrefactive agencies in water may be determined by their action upon organic matter. The test I selected is fresh meat, as the slightest putrescent changes in it can most readily be detected by its smell.

The experiments, which were orignally made with a view of determining the improvement of water by certain filtering media, were, with the exception of experiment VIII., carried out in the following manner:—

On to the perforated bottom (*a*) of a stoneware vessel (*s s*) I place some fresh meat. The vessel is then filled to about two-thirds with the materials to be experimented upon, and lastly with water. Into opening *c* a tin tube is fixed, which is first bent upwards and then downwards in the shape of an inverted U, to prevent any *bacteria* or their germs from passing through this outlet-tube into the bottom of the vessel. The air-pipe *d*, down to *c*, is

* Read before the Royal Society April 19, 1877.

filled with firmly compressed cotton-wool, and a glass tube, sealed at the bottom, passed down through the material experimented upon, to allow of the temperature being measured in close proximity to the meat. The vessels thus prepared are immersed in a boiler filled with cold water, which is gradually heated and kept boiling for several hours. The object of this is to destroy any germs adhering to the meat. The temperature at the bottom of the sealed glass tube was, during the boiling, in each of the following experiments 93·95° C.



After cooling, the Chelsea Company's water was constantly passed through the vessels in the direction indicated by arrows, at as nearly as possible a uniform speed.

It is thus evident that any *bacteria* of putrefaction, or their germs, in the water would, after a time, render the meat putrid, or, if it remains fresh, they must have been absent, or at least inactive, when the water reached the meat.

I now proceed to describe the experiments :—

Experiment I.—One of the vessels was filled with spongy (metallic) iron, and treated as before described; after a fortnight the meat was perfectly fresh.

Experiment II.—A vessel filled with animal charcoal; after a fortnight the meat showed strong evidence of incipient putrefaction. As experiments I. and II. were conducted side by side, this result proves that the preservation of the meat in Experiment I. was not due to any external cause, such as the low temperature then prevailng.

Experiment III.—Water continuously passed through a vessel filled with spongy iron for four weeks; even then the meat was perfectly fresh and hard.

Experiment IV. was a repetition of II., the filtration of water through animal charcoal being continued for four weeks. The meat was soft and quite putrid. In the course of this experiment the exit-tube was several times choked by mucous matter.

Experiment V.—In Experiments I. and III. with spongy iron, this material was employed without separating any of the fine dust. In order to ascertain whether *bacteria* were merely mechanically retained, a vessel was charged with spongy iron, from which all the finer particles had been separated by a sieve with thirty holes on the linear inch. The filtering medium in this case was therefore of a porous nature. After four weeks' filtration the meat was found perfectly fresh.

Experiment VI.—In the previous experiments with spongy iron the meat was in contact with water, from which the iron in solution had not been separated. With a view of ascertaining whether the iron in solution was ths preserving agent, a stoneware vessel was charged underneath the spongy iron with pyrolusite and sand, so as to abstract the iron from the water before it came in contact with the meat. After four weeks' filtration the latter was found perfectly fresh.

Experiment VII.—By a separate experiment I ascertained that the oxygen is completely abstracted from water during its passage through spongy iron. In order to determine whether the absence of oxygen be the cause of the preservation of the meat, and whether the *bacteria* or their germs be killed or can be revived when supplied with oxygen, an evaporating basin was inverted over the meat. This must have retained a quantity of air in its cavity, the air being gradually dissolved by the water in close proximity to the meat. After four weeks' filtration the meat was perfectly fresh; I succeeded in collecting a small bubble of the gas, still in the cavity of the evaporating basin. This was quite free from oxygen.

It is therefore doubtful whether oxygen was supplied to the water sufficiently long to justify any conclusions from this experiment. However, the result of Experiment VIII. rendered a repetition unnecessary.

Experiment VIII.—Fresh meat was placed at the bottom of a glass vessel and left standing, covered with about four inches of spongy iron and water. The vessel in this instance was *not* boiled. After three weeks the meat was very bad, demonstrating that the action of the *bacteria* of putrefaction adhering to the meat was not prevented by the spongy iron above, and if, during the previous experiments with spongy iron, agencies capable of causing putrefaction had at any time come in contact with the meat—in other words, if the *bacteria* had not been killed in their passage through spongy iron,—the meat must, as in this last experiment, have shown marks of their action. It therefore appears that *bacteria* are permanently rendered harmless when passing in water through spongy iron. This conclusion is further corroborated by the observation that even effluent sewage-water, after passing through the spongy material, has remained perfectly bright for now five years, when exposed to light in a half-filled stoppered bottle.

I believe that the action of spongy iron on organic matter largely consists in a reduction of ferric hydrate by organic impurities in water. We know that even such organic matter as straw or branches is capable of reducing ferric to ferrous hydrate. We know that even such indestructible organic matter as linen and cotton fibres is gradually destroyed by rust stains. This action is slow when experimenting upon ordinary ferric hydrate, but it may, *in statu nascendi*, be very energetic—the more so, if we consider the nature of the organic matter in water. Ferric hydrate is always formed in the upper part of a layer of spongy iron, when water is passed through that material. The ferrous hydrate resulting from the reduction by organic matter may be re-oxidised by oxygen dissolved in the water, and thus the two reactions repeat themselves. This would explain why the action of spongy iron continues so long.

It is, however, quite certain that there is also a reducing action taking place when ordinary water is passed through spongy iron. This is clearly indicated by the reduction of nitrates.

Our knowledge of those low organisms which are believed to be the cause of certain epidemics is as yet too limited to allow of direct experiments upon them. It is not improbable that, like the *bacteria* of putrefaction, they are rendered harmless when water containing them passes through spongy iron; but until we possess the means of isolating these organisms, this question can only be definitively settled by practical experience. Should this not be satisfactory, should those specific contagia not be destroyed when passing in water through spongy iron, then the separation of *bacteria* by spongy iron may afford means of isclating those germs of disease, should it be favourable; then we shall have found in spongy iron the material to prevent the spreading of epidemics by potable water.

Action of Salicylic Acid in Typhoid Fever.—Dr. Albert Robin.—In typhoid fever the internal use of salicylic acid reduces the quantity of urine and increases its specific gravity. In health the very opposite is the case. —*Moniteur Scientifique.*

ON THE NEW METAL DAVYUM.

(PRELIMINARY NOTICE.)

By SERGIUS KERN, St. Petersburg.

On the 28th of June, in the residues obtained after the treatment of platinum ores in order to separate the metals of the platinum group, I perceived the presence of a new metal belonging to the platinum group, which has been called by me "Davyum," in honour of the great English chemist Sir Humphry Davy.

The ores under examination had the following average composition :—

	Per cent.
Platinum	80·03
Iridium	9·15
Rhodium	0·61
Osmium	1·35
Palladium	1·20
Iron	6·45
Ruthenium	0·28
Copper	1·02
	100·09

This ore was treated by the well-known analytical process of Prof. Bunsen, and in the separation of rhodium and iridium the presence of Davyum was detected. The precipitate by the action of hydrogen at 100° (impure mixture of rhodium and iridium) was purified by dissolving it in aqua regia. Next it was treated by chlorine in the presence of barium chloride. Water was added, the barium was precipitated and filtered away, and the rhodium and iridium solutions were mixed with a concentrated solution of hydrogen sodium sulphite ($HNaSO_3$).

In some days a precipitate of a light yellow colour was obtained, which was the double sulphite salt of rhodium. The precipitate was filtered off, and the filtrate was heated on a sand-bath in order to obtain the iridium double salt which falls down. The solution from this filtrate, collected from the treatment of 600 grms. of the platinum ore, was concentrated and heated with ammonium chloride and ammonium nitrate in excess, for one hour, at the temperature 60° to 65°. A dark red precipitate was obtained, which on ignition gave a grey spongy mass, and when fused by means of the oxy-hydrogen blowpipe, gave a silvery ingot of Davyum. The weight of the ingot was 0·27 grm.

The metal Davyum dissolves readily in aqua regia. In boiling sulphuric acid the metal dissolves very difficultly. Potassium hydroxide gives a precipitate of a light yellow colour. Sulphuretted hydrogen in acid liquids gives a brownish precipitate, which quickly turns black on being dried. It is a very curious fact that a diluted solution of Davyum chloride with potassium sulphocyanide gives a red colouration identical with the colouration produced by mixing solutions of potassium sulphocyanide with ferric salts. If a concentrated solution of Davyum chloride is mixed with potassium sulphocyanide a red precipitate is thrown down on gently heating the solution,

The specific gravity of the metal Davyum was found to be 9·385 at 25° Celsius. Davyum is extremely infusible, hard, and to some extent ductile.

The new metal may be supposed to occupy the place between molybdenum and ruthenium in the periodical system of elements proposed by Prof. Demetrius Mendeleeff (*Annalen d. Chemie und Pharmacie*, Suppl. B, viii., p. 133; *ibid.*, p. 168). Perhaps Davyum is the hypothetical metal in the periodical system having the atomic weight equal to 100.

The author expects in some months to study more closely the physical and chemical properties of the metal Davyum (Da).

Obouchoff Steel Works.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from vol. xxxv., p. 228.)

Manufacture of Sulphuric Acid. By ROBERT HASENCLEVER, Manager of the Stolberg Works.

Purification of Sulphuric Acid.—The sulphuric acid of commerce generally contains small quantities of lead, iron, and arsenic, besides traces of selenium and thallium. It is only in some few of the arts that a pure acid is required on the large scale, *e.g.*, in the preparation of sulphate of soda free from iron for the plate-glass manufacture. In most cases the iron and lead present in sulphuric acid do not interfere with its applications, and it can be freed from them, if needful, by simple distillation.

The removal of the arsenic is of greater importance, and for this purpose various methods have been proposed. H. A. Smith, in his work already quoted, has given detailed researches on the amount of arsenic acid in sulphur ores. He found in pyrites from :—

		Per cent Arsenic.
Spain	Tharsis	1·651
	Mason	1·745
Belgium		0·913
Westphalia		1·878
Norway		1·649
Do.	rich in sulphur	1·708

On roasting a part of the arsenic remains in the burnt ore; a part is deposited in the flues leading to the chambers; a further portion arrives into the acid, and passes along with this into the various products prepared with its aid, and is finally found in the sulphur recovered from alkali waste. According to Smith there is present in :—

	Per cent Arsenic.
Norwegian pyrites (hard kind)	1·649
Do. burnt	0·469
Sulphuric acid	1·051
Flue dust before entering chambers	46·360
Chamber mud	1·857
Hydrochloric acid	0·691
Salt-cake	0·029
Alkali waste after lixiviation	0·442
Soda	0·000
Regenerated sulphur	0·700

As to the removal of arsenic from sulphuric acid several important observations have been made in the last few years. Bussey and Buignet† have examined the customary methods for the removal of this impurity, and pronounce them insufficient. The precipitation of the arsenic by means of sulphuretted hydrogen or barium sulphide is not complete, and the use of these means involves a considerable dilution of the acid. If we attempt to purify an impure acid by distillation we obtain, under certain circumstances, a product free from arsenic, but in most cases an arseniferous acid passes over. Bussy and Buignet have ascertained the conditions in which a pure acid is obtained. They found that sulphuric acid containing arsenic in the form of arsenic acid can be purified by distillation, but not such as contains arsenious acid. Arsenic acid remains entirely in the residue, whilst arsenious acid passes over. Hence, Bussy and Buignet recommend to treat the commercial acid, which generally contains both arsenious and arsenic acid, with nitric acid, in order to peroxidise the arsenious acid. The acid is

* "Berichte über die Entwickelung der Chemischen Industrie Wahrend des Letzten Jahrzehends."

† Bussy and Buignet, *Dingl. Pol. Journ.*, clxii., 454.

then mixed with a little sulphate of ammonia in order to destroy nitrous acid, and distilled.

Bückner* has modified his original process for the removal of arsenic, which consisted in heating the sulphuric acid with hydrochloric acid. He has perceived that arsenic, when present in crude sulphuric acid as arsenic acid, cannot be removed by hydrochloric acid. To convert arsenic acid into arsenious acid the crude acid to be purified must either be first heated with charcoal and then treated with hydrochloric acid, or the heating with charcoal and the treatment with hydrochloric acid are conducted simultaneously. As experience proves that the acid in most cases contains arsenic acid the treatment with charcoal is to be recommended in all cases.

Blondlot† converts the arsenious acid into arsenic acid prior to distillation not by nitric acid but by manganese peroxide or the manganate of potash.

Lyte‡ proposes to heat the raw acid first to 110° in a bowl with ¼ to ½ per cent sulphuric acid, then to mix with chromate of potash, and finally to distil. The oxalic acid removes nitrous acid, and the chromic acid converts the arsenious acid into arsenic acid.

At Freiberg and Oker sulphuric acid is purified by sulphuretted hydrogen, and this process is particularly recommended as the gas is not conducted into the liquid. The sulphuric acid is allowed to flow down a precipitating tower, fitted with prisms like a Gerstenhöfer furnace, but made of lead and so arranged that an angle is always upwards and a side downwards. Into this tower enters from below a current of sulphuretted hydrogen evolved from green pyrites and sulphuric acid. As the acid flows down in thin layers the precipitation of the arsenic sulphide is very satisfactory.

Concentration of Sulphuric Acid.—The kinds of apparatus generally employed in sulphuric acid works for concentrating the chamber acid are:—

1. Evaporation in leaden pans, standing upon cast-iron plates heated by the direct action of fire beneath the plates.
2. The action of a reverberatory fire upon leaden pans, the edges of which have double sides and can be cooled by a current of water in order to prevent the lead from melting. Or the concentration is effected,
3. By steam.
4. By hot sulphurous acid.

In the application of the first-mentioned arrangement for concentration (open pans with direct fire) the author considers it advisable‖ to regulate the evaporation by the thermometer, as the lead is readily destroyed at a too elevated temperature.

At the commencement of the treatise just quoted the author enters into an examination of the action of sulphuric acid upon lead, and states as the result of his observations that perfectly pure lead is more attacked during the concentration of sulphuric acid than a less pure metal. The same observation had been already made by Calvert and Johnson.§

If the open pans employed in the evaporation are not made of too soft a lead they last for a long time, at least if the concentration is conducted with due care.

Chandelon makes the judicious suggestion that the fire-gases from every arrangement for the concentration of sulphuric acid should be passed into a small separate chimney, since it is not possible to determine if a loss of acid is taking place when steam, hydrochloric acid gas, and the volatile products of the furnaces of a chemical works are all led into one large chimney.

The ordinary concentration in open pans is simple, and is still, therefore, principally in use, though not greatly to be recommended as far as repairs, consumption of fuel, and loss of acid are concerned.

The apparatus in which the flame plays directly over the surface of the acid was at one time widely used in England, and was first introduced into Germany at the Lüneburg Chemical Works. The furnaces last a long time without repairs, and consume little fuel, but are liable to the defect that an excessive temperature is often produced when considerable quantities of sulphuric acid escape along with the products of combustion. On this account such furnaces have been abandoned in many places where they had been introduced.

The idea of concentrating sulphuric acid by the indirect action of steam dates from the year 1865 and is due to Carlier, the manager of the Duisburg Chemical Works. After various experiments tried in this establishment the evaporation, according to the report of F. Curtius, is conducted in wooden chests lined with lead, 4 metres in length and breadth. At the bottom of each chest are two leaden worms, each 45 metres in length, 3 centimetres in width inside, and 7 millimetres in thickness of metal. In order that the condensed water may flow off easily from the pipes the bottom has the form of a blunted pyramid, the receptacle being 0·60 metre high in the middle, and only 0·3 at the ends. Both ends of the piping are in connection with the steam boiler, and can be shut off by means of cocks. The boiler is fixed lower than the concentration chests, which receive their supply of steam from a pipe leading from the dome. The pipes which allow the escape of the steam from the condensation chest slope towards the steam space in the boiler, so as to permit a reflux of the condensed water into the latter. The action is intermittent. The chest is charged with acid at 1·5 sp. gr., and heated by steam till the sp. gr. rises to 1·7. The entire contents of the chest are then run into a wooden cistern lined with lead. In this reservoir there is a worm through which the chamber acid must pass on its way to the concentration chest, so that the latter is always fed with acid already warmed. The pressure of steam in the boiler amounts to three atmospheres, and an apparatus of the size given yields in twenty-four hours 5000 kilos. of acid at sp. gr. 1·7. The consumption of coal is 9 kilos. per every 100 kilos. of concentrated acid. The waste of lead amounts to 0·2 kilo. per ton of acid. The boiler only requires to be supplied with water to compensate for the escape through faulty joints. It is recommended to fence in the concentration chest with a wooden screen to prevent the workmen from being injured by the hot acid scattered abroad if a steam pipe should burst.

Delplace observed at the Stolberg Works that the leaden steam pipes are principally attacked just where they plunge into the acid. The dust, which, even though slight, still gradually accumulates upon the pipes, causes by its capillary attraction the sulphuric acid to rise a few centimetres above the level of the liquid in the pan. This acid is quickly concentrated by the steam, and thus rapidly occasions a strong corrosion of the lead. To meet this defect at the place where the pipe plunges into the acid a leaden bell is blown on, opening upwards, and of rather larger diameter than the pipe itself. The outer leaden surface of the bell is still coated with a thin damp layer of dust, but which is no longer heated by the steam.

Concentration by steam has been of late years widely adopted. No sulphuric acid is lost on account of the low temperature employed, and the process has the further advantages of cleanliness, of a very small consumption of coal, and of an important saving of labour.

(To be continued.)

Extraction of Arsenic from Magenta Residues.—M. Cl. Winckler's process consists in supersaturating with soda the mother-liquors from the purification of magenta contained in the crude product as arseniate of rosanilin, and on the reduction of the arseniate of soda by charcoal in presence of carbonate of lime.—*Chemisches Centralblatt*, vii., p. 651.

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* Bückner, *Bayer Kunst. u. Gewerb.*, 1864, 480.
† Blondlot, *Comptes Rendus*, lviii., 76.
‡ Lyte, CHEM. NEWS, x., 172.
‖ Hasenclever, *Brr. Chem. Ges.*, vi., 502.
§ Calvert and Johnson, *Comptes Rendus*, lvi., 140; *Dingl. Pol. Journ.*, 1863, 358.

ON THE

ABSORPTION OF ANTIMONY AND ARSENIC FROM A SOLUTION OF THEIR OXIDES IN HYDROCHLORIC ACID BY CHARCOAL.*

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

Some time back I showed† that charcoal, when freshly made or ignited, absorbs, from their aqueous or acid solutions, several substances not before known as being affected in this manner, and I proposed to apply this reaction to the purification of certain of our chemical reagents from substances difficult or tedious to remove by the processes now in use for this purpose.

Since then I have made further investigations in this direction, and find that antimony and arsenic can be so largely removed from solutions of their oxides or chlorides in moderately strong hydrochloric acid (with a little tartaric acid in the case of antimony) by fresh charcoal, that neither of them can be detected therein by Reinsch's test, although before such process was applied both were abundantly evidenced to the test named.

Thus commercial sulphuric and hydrochloric acids diluted with a little water can be purified from either of these substances by agitating them intermittingly for a short time with fresh charcoal, and then filtering off; application of heat to the mixture expedites this result.

The charcoal used does not appear to give up any portion of either the antimony or arsenic when digested with aqueous solution of potash, hence I consider it very probable that it would absorb either of these metals from alkaline solutions also. Such charcoal, however, when placed in voltaic contact with pure zinc in hydrochloric acid, evolves antimoniuretted or arseniuretted hydrogen (as the case may be) very perceptibly, and it can be wholly divested of either of these substances, when treated in this manner.

In connection with this evolution of such hydrides from charcoal under the circumstances just stated, I will observe here that sulphur, when absorbed by charcoal, is as I have already shown,‡ also given off, and as a hydride, when the charcoal containing it is connected voltaically with zinc in suitable acids, whereas hot aqueous solutions of potash do not seem to dissolve this sulphur. It appears, therefore, that the character of the absorption of sulphur by charcoal is the same as that of the absorption of antimony and arsenic by this substance.

In examining for minute quantities of either antimony or arsenic by Reinsch's or Marsh's test, I would recommend that the acids used for this (even though purporting to be free from these metals) be filtered through fresh charcoal just before using them, as they frequently extract small quantities of these impurities from the bottles in which they are stored.

* Read before the Wellington Philosophical Society, January 29th, 1876.

† Chemical News, March 27, 1868.

‡ Chemical News, vol. xxvii., p. 216.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY OF EDINBURGH.

June 4, 1877.

Mr. J. Y. Buchanan, Chemist of the *Challenger* Expedition, read a paper on "*Air Dissolved in Sea-Water.*" He showed the water-bottle which he invented, and which was used for collecting the "intermediate waters." It consists of a metal cylinder with tap at each end, connected by a metal rod bearing a flap, which falls into position when the bottle ceases to descend and is being "hove in;" the pressure of the water rushing past it causes it to descend and shut the taps, thus enclosing the desired sample of water. The apparatus for boiling out the oxygen and nitrogen, and that for determining the carbonic acid, were illustrated by diagrams, which also afforded an idea of the arrangements inside the miniature laboratory on board the *Challenger*. The general results of investigations made went to show that while the absolute amount of oxygen and nitrogen capable of being dissolved is less in the case of sea-water than in that of fresh water, the proportion between the amounts of the two gases dissolved remains nearly the same; that the absolute amount dissolved both of permanent gas and of carbonic acid depends on the temperature; that in no case is there more gas dissolved in water taken from any depth than it would be capable of absorbing from the atmosphere in regions where the same temperature prevails at the surface; that, in fact, the water at great depths preserves all the physical properties which it had when it left the surface, including temperature, specific gravity, and gaseous contents (with the exception of the proportion of oxygen). The belief in the existence of water at great depths so charged with gas as to effervesce when brought to the surface is not wholly false. This phenomenon is observed when water is brought from great depths in the hot equatorial and tropical regions. Near the bottom the water may have a temperature bordering on the freezing-point, and will contain a corresponding amount of air. Brought to the surface, where the temperature may be between 80° and 90° F., it can no longer contain the same amount of gas; and if in a glass vessel, the walls will be seen to clothe themselves with minute air-bells, somewhat like natural Seltzer water which has stood for a little time in an open vessel. At the surface the percentage of oxygen varies between 33 and 35 per cent, the higher number having been observed in a water collected almost on the Antarctic circle; the smallest percentages have been found in the Trade-wind districts. In bottom waters the absolute amount is greatest in Antarctic regions, and diminishes generally towards the north. The oxygen percentage is greatest over "diatomaceous oozes," and least over "red clays" with peroxide of manganese, and over "blue muds" it is greater than over "globigerina oozes." In intermediate waters the very remarkable fact was observed that the oxygen diminishes down to a depth of 300 fathoms, where it attains a minimum, after which it rises. The following figures will show the nature of this phenomenon:

Depth (fathoms) ..	0	25	50	100	200	300	400	800	Between 800 and bottom.
Oxygen (N + O = 100)	33·7	33·4	32·3	30·2	23·4	21·4	15·5	22·6	23·5

It is evident from these figures that between 200 and 400 fathoms there is a great consumption of oxygen going on, and, as it is difficult to conceive its being consumed otherwise than by living creatures, the conclusion is forced on us that animal life must be particularly abundant and active at this depth, or at least more abundant than at greater depths; for at less depths there is more opportunity of renewal of the oxygen, by reason both of the greater proximity to the surface and of the existence of vegetable life. This conclusion was borne out by the numerous experiments made by Mr. Murray with the townet at intermediate depths, which went to prove the existence of abundance of animal life down to 400 fathoms, vegetable life never extending to much below 100 fathoms. Below 400 fathoms life is sparingly met with.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

June 25th, 1877.

Prof. A. W. Hofmann, F.R.S., Vice-President, in the Chair.

Dr. R. Biedermann and Dr. S. Gabriel have investigated the cause of "*The Red Spots on Yellow Bricks*," and finds that they are not due to the presence or Fe_2O_3, but

to sulphuric acid. Analyses of the red portions of the bricks, and of the main mass, showed respectively 11·10 and 0·80 per cent SO_3. These spots result only when coal is used for fuel, the SO_2 vapours uniting with aqueous vapours and being confined by the CaO in the clay.

Prof. A. W. Hofmann presented a second communication "*On the Polysulph-hydrates of the Alkaloids*" (Chemical News, xxxv., p. 240). Attempts had been made without result to prepare polysulphides analogous to the polyiodides, similar, for instance, to the iodine derivatives of tetra-methyl-ammonium. Even methyl-strychnine yielded no polysulphide by the action of $(NH_4)_2S$, as is the case with strychnine itself. On the contrary, it was found that other alkaloids yielded polysulphydrates when the conditions of the reaction were changed. A hot solution of brucine gave upon addition of $(NH_4)_2S$ a compound identical with that obtained by Schmidt through the action of air and H_2S on brucine, to which the latter assigned the formula—

$$C_{23}H_{26}N_2O_4(H_2S_2)_2.$$

The analysis of this body with As_2O_3 shows, however, that H_2S_8 is contained in it, and that the formula is—

$$2C_{23}H_{26}N_2O_4.H_2S_8.$$

It decomposes like the analogous strychnine compound under the formation of an oily substance, showing the general properties of persulphide of hydrogen. Reference was made to the investigations by Ramsay on this subject, who prepared a polysulphide the analysis of which ranged between the limits H_2S_7 and H_2S_{10}.

Prof. Hofmann exhibited also an ingenious contrivance for the "*Rapid Preparation of FormicAldehyd.*" It consists essentially of a platinum tube containing platinum wire, through which air laden with the vapours of methyl-alcohol passes. The arrangement is such that the heat generated by the formation of the aldehyd is used to prevent the fall of temperature in the supply of CH_4O consequent upon the rapid evaporation. The simplicity of the construction, as well as the rapidity and ease with which the operation is conducted, will render it convenient for the preparation, not only of other aldehyds, but also of many other bodies.

The following communications have been received from non-resident members:—

R. Schiff, "*Derivatives of Furfurine and Furfuramide.*" Both of these compounds yield with nitrous acid an interesting series of compounds. Furfurine is not attacked by nascent hydrogen or mustard oils. It forms, however, a well defined acetyl compound, and a hexa-bromo-acetyl-furfurine has been prepared, which the author regards as consonant with the assumption of a quadrilateral union of carbon atoms in the molecule.

A. Atterberg has examined the crude "*Wood-Spirit from Norwegian Pines*," and found in the higher boiling portions, besides australine and another known homologue, a new turpentine, to which he assigns the name *sylvestrine*.

C. Zulkowsy, "*Constitution of Rosolic Acid.*" The author prepares rosolic acid (aurin) by the action of H_2SO_4 on 1 molecule phenol and 2 molecules cresol. If, then, rosaniline receives the formula—

$$C_6H_3NH_2\begin{matrix}\diagup CH_2.C_6H_4NH\\ \diagdown CH_2.C_6H_4NH\end{matrix}'$$

rosolic acid would be—

$$C_6H_3OH\begin{matrix}\diagup CH_2.C_6H_4O\\ \diagdown CH_2.C_6H_4O\end{matrix}.$$

C. Böttinger finds a good "*Absorbent for Carbon Monoxide*" in hydrocyanic acid surrounded by a cooling mixture. Concentrated hydrochloric acid does not mix with the solution. On removal from the cooling mixture a regular stream of CO is evolved.

R. S. Dale and C. Schorlemmer notice the "*Formation of Leucaniline from Rosalic Acid*" when heated with alcoholic ammonia at 150°.

A. Ladenburg, "*Condensation Products in the Ortho Series.*" Para-meta-toluylen-diamine and formic acid yields, on being heated together for some time, a base melting at 100°, methenyl-toluylen-diamine—$C_7H_6N_2H.CH$. Ortho-amido-phenol gives, with the same treatment, methenyl-amido-phenol, $C_6H_4O.N..CH$. Para-meta-toluylen-diamine and phthalic anhydride yield diphthalyl-toluylen-diamine $C_7H_6(NC_8H_4O_2)_2$. Para-meta-toluylen-diamine forms, with benzaldehyd, dibenzyl-toluylen-diamine, $C_7H_6(N..C_7H_6)_2$. Other aldehyds appear to form analogous compounds. Ortho-toluidine and formic acid yields formo-toluide, $C_7H_7NH.CHO$, melting at 57°. An isomeric isoformo-ortho-toluide is obtained by distilling oxalic acid and ortho-toluidine. The former compound yields, by long exposure to heat, a base, C_8H_9N, probably situated between indol and methyl-ortho-toluidine. The author describes also various attempts to prepare indigo synthetically from ortho-toluidine. The hydrochlorate yields, with Fe_2Cl_6, a colouring matter, which he names toluidine blue, but which is in essential characteristics different from indigo. Formo-toluide gives a similar colouring matter. With indol a green colouring matter was obtained.

H. Weidel and M. v. Schmidt, "*Modification of Sauer's Method of Estimating Sulphur.*" In order to insure a complete decomposition of organic bodies containing sulphur, as well as an entire oxidation of the sulphurous acid formed, the substance so be analysed is mixed with six times the weight of fused boric acid in a platinum boat, and undergoes combustion in a stream of oxygen in a glass tube containing platinum black. The method is especially advantageous in the analyses of the salts of the higher sulpho acids in the aromatic series.

W. Lenz, in the course of an examination into the influence exerted by the atoms Fl, Cl, Br, and I, on the character of a para-halogen-benzene-sulphonic acid, examines, first, "*Para-iodo-benzene-sulphonic Acid*," $C_6H_4ISO_3H$. The acid was prepared by the action of HI on diazo compound derived from sulphanilic acid. A number of salts are described. The author obtains also from this diazo compound with HFl, para-fluoro-benzene-sulphonic acid, $C_6H_4FlSO_3H$. All of its derivatives, with the exception of the amide, are exceedingly soluble.

H. Weidel and M. Gruber, "*Action of Bromine on Tri-amido Phenol in the Presence of Water*". This reaction yields in very large quantities a finely crystallising body, $C_{18}H_7N_3Br_{II}O_7$. to which the name *bromo-dichromazine* is assigned for the present. It is dichroitic, and does not enter into union with acids. The only compound of a character of a salt results from the action of mercuric acetate, and consists of yellow crystals. Sulphuric acid causes the formation of bromo-dichroic acid, $C_{18}H_7Br_{II}O_{II}$, easily soluble, possessing strong acid properties, and decomposing below 100°. Fusion with KOH gives rise to resorcin. By the action of HNO_3, as well as of Br and water, on bromo-dichrom-azine, the latter is changed into hexabrom-aceton, C_3Br_6O. The character of the latter was shown by various reactions. Alkalies give rise to bromoform; nitric acid causes the formation of bromopicrin. In harmony with the formation of dibrom-acetamide from penta-brom-aceton, ammonia changes it into tribrom-acetamide, $C_2Br_3ONH_2$, melting at 120°, uniting with neither acids nor bases, and changed by H_2SO_4 into tribrom-acetic acid. Hexabrom-aceton forms isopropyl alcohol on treatment with sodium amalgam. The bromo-dichroic acid appears to correspond with the compound mairogallol, $C_{18}H_7ClI_{II}O_{II}$, obtained by Stenhouse from the action of chlorine on gallic acid.

A. Ladenburg, "*On Ammonium Compounds.*" Additional proof is brought to defend the existence of two isomeric triethyl-benzyl-ammonium iodides. "*Benzene Formulæ.*" The author defends his prism-formula against the criticisms of Van't Hoff.

R. NIETZKI, "*Amido-Azo Compounds of the Toluyl Series.*" Meta-toluidine yields, with nitrous acid, met-amido-azotoluen, crystallising in dark blue needles, and forming red solutions when in combustion with acids. Meta-toluidin-hydrochlorate and para-diazo-amido-toluene form metamido-para-azo-toluen, crystallising in yellow leaflets. The author finds that when ortho-toluidin (but not meta or para-toluidin) is brought in contact with para-diamido-toluen and ferric chloride, an intense green colouration ensues.

E. WIDNMANN, "*Nitrobenzoic Acids.*" The melting-points of various mixtures of the isomers are arranged together in a table, and mentioned in connection with the late statement of Liebermann on the subject (CHEMICAL NEWS, vol. xxxv., p. 263).

NOTICES OF BOOKS.

The Art of Electro-Metallurgy, including all Known Processes of Electro-Deposition. By G. GORE, LL.D., F.R.S. London: Longmans, Green, and Co. 1877.

THIS highly interesting and instructive treatise is divided into four very unequal parts, the first of which gives an historical sketch of the subject, and the second the laws and principles upon which the art is based. The longest and most important division of the work treats of the practical part of the art, and this extends over more than two-thirds of the book, while the fourth division—which is intended for the use of practical operators—contains an account of special practical operations of a highly technical character. A list of all the English patents (nearly 300 in number) relating to that subject is given at the end of the work, together with the titles of books on electro-metallurgy.

Starting with the observation of Sulzer made in 1752, to the effect that if lead and silver be placed on opposite sides of the tongue, a peculiar taste is produced when they touch, Mr. Gore passes on to the decomposition of water by static electricity, which was accomplished by Paetz and Van Troostwik in 1790. The real history of the subject commences with Volta's Crown-of-Cups, the first means of producing a current of electricity for any continued length of time. The invention of Cruikshank's battery followed shortly afterwards. Nicholson and Carlisle decomposed water in 1800, and Henry, of Manchester, decomposed nitric and sulphuric acids a few months later. In 1801 Wollaston observed that a piece of silver in connection with the positive end of the battery is coated with copper, if it be placed in a solution of that metal; and in 1805 Brugnatelli gilded two silver medals, by making them the negative pole in a saturated solution of ammoniuret of gold. He also deposited silver upon platinum by a similar process. In 1836 Mr. De la Rue observed that in Daniell's battery the copper plate is covered by a coating of metallic copper, which, on being stripped off, presents an exact counterpart of every inequality of surface of the plate on which it was deposited. Two years later Professor Jacobi, of St. Petersburg, published an account of his galvano-plastic process (*Athenæum*, May 4th, 1839):—"A method of converting any line, however fine, engraved on copper, into a relief by galvanic process, applicable to copper plate engravings, medals, stereotype plates, ornaments, and to make calico-printing blocks, and patterns for paper-hangings." Mr. Spencer, of Liverpool, announced a paper on the *Electrotype Process* on May 8th, 1839; it was read before the Liverpool Polytechnic Society on Sept. 13th of the same year. A detail account of Spencer's paper is given (pp. 7-18). Messrs. Elkington, in conjunction with Mr. O. W. Barratt, patented a process of electrotyping in July, 1838, but the results were not very satisfactory, until Wright proposed the solution of cyanides of gold and silver in alkaline cyanides, as a liquid for electrotyping purposes. This idea he obtained from a passage in Scheele's "Chemical Essays," in which mention is made of he solubility of the cyanides of gold and silver in an excess of the precipitants. Messrs. Elkington took out another patent in connection with this subject in 1840, but they speedily adopted Wright's process. Two years later Woolwich took out a patent for the use of a magneto-electric machine for electro-plating, and although this was employed for several years, it was eventually superseded by newer forms of magneto-electric machines. In 1841 Mr. Smee published a long series of results of experiments on the deposition of various metals. "The chief improvements which have been made in electro-metallurgy since the year 1847 have been the gradual extension of the process for multiplying printing surfaces, in stereotyping, &c.; also the producing of works of art of increased size, in copper, until deposits several tons in weight have been attained; the extensive use of nickel, as a coating upon harness, furniture, &c., the protection of articles of cast-iron, ornamental lamp-posts, &c., from rusting, by a coating of copper; the substitution of magneto-electric machines, and thermo-electric piles, for voltaic batteries; the purification of crude copper in the process of copper smelting; and, quite recently, the economical production of copper-ed-iron rollers for calico printing, by means of magneto-electric deposition."

The second division of the work treats of the theoretical principles of electro-metallurgy; the elementary facts of electricity, the formation of a current, and the electrical relations of metals.

The next division discusses the practical methods of the art; the general processes of depositing metals, and this is followed by an account of the deposition of individual metals, commencing with hydrogen. Mr. Gore gives his own very interesting experiments on electro-deposited antimony, and on the electrolysis of hydro-fluoric acid in some detail, and very many experiments on the electro-deposition of various metals. Detail accounts are given of the processes of gilding and silvering, and the extraction of the precious metals from old solutions.

Gerboin, in 1801, observed that mercury exhibits peculiar movements when it acts as the electrode in electrolysis, and the phenomenon was also investigated by Sir Humphry Davy, Sir John Herschel, and others. Lippmann attributed the effect to a change in the capillary constant. Mr. Gore, while investigating these movements, observed that the surface of the mercury was covered with waves, and that a faint sound was emitted. These *electrolytic sounds* and the motion were found to be due to the alternate formation and destruction of films upon the surface of the mercury.

The method of refining copper by electrolysis is now largely practised, and several hundred tons of the metal are yearly produced by this means. All the impurities are eliminated, and the deposited metal is quite pure. Copper has also been analytically estimated by electrolysis.

In the section which treats of the deposition of the metalloids, Mr. Gore mentions that he has electro-deposited pure carbon from the carbonates of potassium and sodium in a state of fusion; the deposit was black and amorphous, "it burned with a glow, and left a residue." Liquefied carbonic anhydride does not conduct a current from 40 of Smee's elements. According to De la Rue it is not decomposed by the current from 5640 cells of a chloride of silver battery.

The final fifty pages of the work are devoted to special technical processes, and is chiefly designed for those who desire to practise the art of electro-metallurgy. The arrangement of the buildings, depositing vats, and machinery is described in detail, also the various forms of battery. According to Latimer Clark the relative strength of batteries is as follows:—

Grove's	100	Smee's (when in action)	25
Bunsen's	98	Wollaston's Copper and Zinc in dilute acid..	46
Daniell's	56		
Smee's (when not in action	57		

Mr. Gore is to be congratulated upon the valuable work which he has written; he has spared no pains to make it as complete as possible, and we have no doubt that it will become a standard work in the hands of those who are interested in the subject.

CORRESPONDENCE.

THE NEW NICKEL MINERALS FROM NEW CALEDONIA.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxiv., p. 193) there is a communication from Mr. Typke, in which he comments upon a little paper of mine relating to the new nickel minerals from New Caledonia, read before the Chemical Society of London in 1874.

Mr. Typke states that he submitted the ore to a fresh investigation at the "instigation of Mr. Valentin," and that, as the results which he obtained differed in many respects from those obtained by me, he was induced to make them public.

I am not at all surprised to learn that his sample gave different results, for, as I have already pointed out, the ore varies in composition, and there are at least two fairly well-defined varieties of the mineral.*

I do not think that Mr. Typke was quite entitled to assume that the mineral which he examined must necessarily be similar to the one which I examined simply because they possessed somewhat similar physical properties, chemical composition, and both came from New Caledonia: they may or may not be the same mineral; probably they are, although it is not improbable that several different nickel minerals may be found in these new Caledonian deposits.

But I would remark that the amount of variation in composition which I have met with during the examination of numerous specimens of the different verieties has not been greater in degree than is often the case in many typical and universally recognised mineral species. I have, however, not yet met with a specimen which gave on analysis such a small proportion of magnesia as that obtained by Mr. Typke. I have found that, unless strong hydrochloric acid be used for the solution of the mineral, there is a risk of leaving some of the magnesia behind in the residue: the majority of the magnesian silicates, it is well known, are but partially or only soluble with difficulty in dilute acids; and in some varieties of the new Caledonian nickel minerals, certainly part of the silicate of magnesia appears to be mechanically mixed with the nickel silicate, even in cases where the mineral to the naked eye appears to be perfectly homogeneous. This is proved by the microscope.

Mr. Typke states that he only employed dilute acid for the solution, and determined the silica by evaporating the whole down to dryness and igniting: it is not mentioned that the silica was tested as to purity—a very necessary thing to do under the circumstances.

Mr. Typke remarks—"Mr. Liversidge ignited his mineral till it ceased to diminish in weight, but does not appear to have observed that after ignition the nickel was no longer soluble, either in hydrochloric acid or aqua regia, whilst before ignition it dissolved freely in dilute hydrochloric acid, leaving insoluble white granular silica behind. The nickel silicate of the mineral, being in the hydrated condition, is converted by strong ignition in a platinum crucible into the *insoluble* anhydrous silicate."

I cannot understand why Mr. Typke should lay so much stress upon the alleged insolubility of the mineral after ignition. I certainly did not observe that the mineral became entirely insoluble after ignition, but I did observe that it was only partly soluble. It is such a common thing for minerals to be less soluble after ignition, and especially in the case of silicates, that it was not considered a characteristic property of these nickel minerals; and, moreover, it is not usual to ignite a mineral strongly before attempting its solution in acid.

Even in cases where the sample of the nickel mineral has been raised to a white-heat for some time, in Fletcher's powerful blast-furnace, a certain part of the nickel present was found to dissolve in hydrochloric, and readily yield a rich green-coloured solution of nickel chloride. The degree of solubility after ignition varies in different varieties of the minerals.

Surely Mr. Typke has not so misread my paper as to be under the impression that I estimated the nickel and other substances in the portion ignited for the estimation of the combined water.

From the unpublished analyses which I have by me the minerals appear to be fairly constant in composition, —*i.e.*, when it is borne in mind that they are evidently the more or less recent decomposition products of other compounds.

The analyses which were published in the *Journal of the Chemical Society* and volume of the Royal Society of New South Wales were made upon the first specimens which came into my hands, and as they had all been repeatedly immersed in water to show their beautiful colour to greater advantage no determinations were made of the water expelled at 100° C.

I must plead my long absence from the Colony as an excuse for the delay in completing my examination of these very interesting minerals, but I hope shortly to have the results ready for publication.—I am, &c.,

ARCHIBALD LIVERSIDGE.

The University of Sydney, New South Wales,
May 12, 1877.

* For additional analyses see "New Nickel Minerals from New Caledonia," by A. L. *Trans. Roy. Soc. of N. S. Wales.*

DE HAËN'S PROCESS.

To the Editor of the Chemical News.

SIR,—In reference to the letter of Mr. F. Versmann, Ph.D (CHEM. NEWS, vol. xxxv., p. 251) I beg to say I had no thought of depreciating De Haën's process in the communication to which he refers. In saying "there was nothing new in it" I meant that, although not advertised, all its principles had been in vogue for say eight or ten years; for it simply consists of two operations,—first, the separation of lime dissolved by CO_2 by a further addition of lime, and this has been in use in this country as "Clarke's process" for many years, and has been most admirably carried out by Mr. Homersham. C.E., at Caterham and at Tring, where I saw it at work ten years ago.

With regard to the barium, I have been in the habit for many years of prescribing its use for boiler waters largely charged with sulphate of lime.

The "important addition" which I mentioned, and which Dr. Versmann would like to have explained, I cannot just yet very prudently publish, but it had reference to getting rid of the CaCl left in the water, and which, as its density increases by evaporation, causes priming, and is otherwise inconvenient.

In the same number Mr. Andrews refers to Mr. F. G. Rowan's paper on "Boiler Incrustations," &c., which I regret I have not read; but he quotes as follows:—"Prof. Mills informs me that J. Y. Buchanan (of the *Challenger*) was the first who observed that chloride of barium decomposes sulphates and liberates CO_2 from water." Of course

the first part of this quotation is a misconception, because it has been familiarly known to every chemist for twenty years or more that BaCl decomposes sulphates; but it is to be regretted that Mr. J. Y. Buchanan gives no explanation why BaCl promotes the liberation of *free* CO_2 from water whilst boiling, any more than any other fixed salt of difficult solubility, and I should be obliged to any of your correspondents who can explain this remarkable physical property attributed to BaCl, so opposite to its chemical affinity.

Five years ago a French chemist, who had been very successful in taking deposits from boiler-water in Vienna, was in this country: he used lime to fix the CO_2 on Clarke's plan, and soda to deposit lime from the sulphate, and instead of large settling tanks he used compact covered filters, charged with charcoal and wood chips packed tight; but his process cannot be made plain without a diagram, and it must be remembered that when soda is used, sulphate of soda is left in the boiler, which increases much more rapidly than the chloride of calcium which barium leaves in it.—I am, &c.,

Alfred Payne, F.C.S.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 23, June 4, 1877.

On Vapour Densities.—M. H. Sainte-Claire Deville.—The author has shown in a former communication that the volumes of oxygen, chlorine, hydrochloric acid, and hydrochlorate of ammonia, whose weights are equivalent to 39 grms. of potassium, are among themselves respectively as the numbers 1, 2, 4, and 8. It is easily shown that simple bodies represent 1 or 2 volumes of vapour; that the binary compounds represent 2 or 4 volumes; and that, lastly, we only find 8 volumes in very complex bodies, in particular in salts with volatile bases and acids. The author has never been able to understand (and many atomists are of the same opinion) why, without strict proof, an attempt has been made to erase from the number of bodies which may exist in the state of vapour those which represent 8 volumes. He gives in the present paper a summary of the arguments against this attempt.

Researches on the Law of Avogadro.—M. A. Wurtz.—The author maintains, in opposition to M. Troost, that the vapour of chloral hydrate is entirety dissociated.

Atomic Notation.—M. A. Wurtz.—A reply to M. Berthelot's recent paper.

Atoms and Equivalents.—M. Berthelot.—A reply to the above memoir of M. Wurtz in continuation of the controversy which has occupied the last three sittings of the Academy of Sciences. M. Fizeau then expressed the opinion that M. Berthelot had thrown some doubts upon the value of the law of Dulong and Petit, a charge which M. Berthelot repelled. He remarked that between atomic weights deduced from the specific heats of solids, quantities variable with the temperature, whose theoretic signification is obscure, and which are not the same for the different elements, and the atomic weights deduced from gaseous densities, quantities which are constant, and which answer to well-defined physical laws, there is a formal contradiction.

Parallel Striæ Presented by the Surface of Fragments of Diamond of the "Carbonado" Variety, and on their Imitation by Artificial Friction.—M. Daubrée.—Natural fragments of carbonado diamond are often found with striated surfaces, which seem to result from the friction formerly exerted upon them by other specimens of the same mineral. Hence it is probable that the fragments in question, before being scattered and remote from each other as at present, were in contact, so as to exert mutual pressure upon each other.

Certain Metallic Selenides and Tellurides.—M. J. Margottet.—A chemical and physical examination of the tellurides and selenides of zinc and cadmium.

Oxides of Iron.—M. H. Moisson.—If ferric oxide obtained by calcining oxalate of iron is heated to 350° in a current of pure hydrogen for thirty minutes the result is a black magnetic powder, not pyrophoric, and having the composition of magnetic oxide. It is not a mixture of ferric oxide and metallic iron. If ferric oxide is kept for twenty minutes in a current of pure dry hydrogen at 500° we obtain a black powder duller than the former, magnetic, pyrophoric, and having the composition and properties of ferrous acid. At 500° it decomposes carbonic acid, and becomes transformed into magnetic oxide. If ferric oxide is reduced by hydrogen at 700° we obtain metallic iron which is not pyrophoric. At 1000° the pyrophoric ferrous oxide obtained at 440° loses its properties. There are, therefore, two allotropic ferrous oxides.

Preparation and Composition of Emetine.—MM. Lefort and F. Wurtz.—The composition of emetine is $C_{28}NH_{20}O_5$. It forms merely basic salts.

Diffusion of Strontia in Mineral and Organic Matter, both at Present and in Geological Epochs.—M. L. Dieulafait.—Strontia exists in sea-water as carbonate and sulphate in 120 species of fossil *Brachyopodes* taken from the entire series of palæozoic formations in all beds of gypsum, and in all mineral waters examined by the author.

Observations with reference to M. Yvon's Paper on the Nitrates of Bismuth.—M. A. Ditte.—The author has previously (*Comptes Rendus*, 1874, pp. 956 to 960) obtained most of the results described by M. Yvon.

Combinations of Quercite with the Butyric and Acetic Acids.—M. L. Prunier.—Not adapted for abstraction.

Detection of Salicylic Acid in Wines and Urine.—M. E. Robinet.—Take 100 c.c. of the suspected fluid, precipitate with acetate of lead in excess, filter, add an excess of sulphuric acid to throw down the lead, and filter again. The perfectly clear liquid is then treated with a few drops of a solution of ferric chloride. If the least trace of salicylic acid is present, say 2 or 3 milligrms. per litre, or 1 milligrm. in case of urine, a beautiful and characteristic violet colour is produced. An excess of sulphuric acid must always be present. To detect if the sulphuric acid employed contains traces of iron it may be diluted with 10 parts of water, and a small quantity of salicylic acid added. If the sulphuric acid contains the smallest trace of salts of iron the violet colour at once appears.

Observations Relative to M. Bert's Experiments on Carbuncular Disease.—M. C. Davaine.

Experiments Proving that in Poisonous Putrid Blood there is no Virus, Liquid or Solid, except Organised Ferments.—M. V. Feltz.—These two papers are a reply to the experiments of M. Bert, and to the conclusions founded upon them.

Bulletin de la Societe Chimique de Paris, No. 7, April 5, 1877.

Extraction of Caffein.—MM. Legrip and A. Petit.—Already noticed.

Determination of Piperine in Peppers.—MM. P. Cazeneuve and O. Caillol.—The ground pepper is treated with twice its weight of slaked lime in a large quantity of water. The whole is heated to a boil for fifteen minutes. The mixture is then dried in a water-bath, and the piperocalcareous powder is placed in the authors' continuous digesto-distillatory apparatus and exhausted with com-

mercial ether. The liquid is partially distilled off, and the residue is abandoned to spontaneous evaporation, when the piperin is obtained in voluminous crystals tinged slightly yellow by a trace of resinous matter. By recrystallisation from boiling alcohol it may be obtained in prismatic crystals of a very pale yellowish tint—its normal colour. White Singapore pepper contains 9·15 of piperine; that of Sumatra ranges from 7·15 to 8·10 per cent, whilst Penang pepper falls as low as 5·24.

Phosphide of Zinc.—M. H. Hager.—This compound is prepared by allowing the vapour of phosphorus to act upon melted zinc in a current of hydrogen. Its specific gravity is 4·72, and it contains 25 per cent of phosphorus.

Preparation of Iodide of Arsenic.—M. Badcock.—Arsenious acid is dissolved in hydriodic acid, and evaporated to dryness. The compound is thus obtained in yellow crystalline scales, completely soluble in water.

Hypovanadic Acid and its Compounds.—J. K. Crow.—Taken from the *Journal of the Chemical Society*.

Presence of Vanadium in Uranic Oxide.—Carrington Bolton.—From the *American Chemist* for 1876, p. 363.

On the Pyrosphosphates of Lithium, Lithium and Sodium, and Lithium and Potassium.—MM. Nahnsen and Cuno.

Action of Hydrochloric Acid on Chlorate of Potassium.—M. Schacherl.—These two papers are taken from *Leibig's Annalen*, to the abstracts of which the reader is referred.

A number of papers follow, all taken either from the *Berichte der Deutschen Chemischen Gesellschaft*, from *Liebig's Annalen*, or from the CHEMICAL NEWS.

Determination of Sugar.—M. R. Sacchse.—The author has tried the method recommended by Knab, (tome xiv., p. 215), founded upon the reduction of mercury cyanide in an alkaline solution by means of glucose. As an indicator to mark the end of the reaction, he makes use of an alkaline solution of stannous oxide, which, in a drop of the solution of mercury cyanide placed upon a white porcelain slab, gives a black spot more or less inclining to brown, according to the proportion of mercury. When all the mercury has been reduced by the sugar, a spot is no longer produced. The indication is very exact, but the results of the method are not constant. The author finds that an alkaline solution of mercuric iodide may advantageously be substituted for the mercuric cyanide. 18 grms. of pure mercury iodide are dissolved in an aqueous solution of 25 grms. of potassium iodide, 80 grms. of caustic potassa are added, and the solution is diluted to 1 litre. To make use of this solution 40 c.c. are placed in a capsule, brought to a boil, and the saccharine liquid introduced by means of a burette. Experiments made with pure glucose show that 40 c.c. of the mercuric liquid (0·72 grm. HgI_2) correspond on an average to 0·1501 grm. glucose. In other words $2HgI_2 = C_6H_{12}O_6$. Inverted sugar reacts upon the mercuric iodide in other proportions than glucose (dextrose) as 40 c.c. correspond to 0·1072 grm. of inverted sugar.

New Salt of Iron for Steeling Copper Plates for Engravers.—M. R. Bœttinger.—The author dissolves 10 grms. prussiate of potash and 20 grms. salt of seignette in 200 c.c. of water. He then adds 3 grms. of ferric sulphate in 50 c.c. of water, when a precipitate of Prussian blue is produced. A solution of caustic soda is then added drop by drop till this precipitate is re-dissolved. A clear yellow solution is thus obtained which may he used for depositing iron upon copper. The same liquid may serve for dyeing cloth blue. It is steeped in the liquid, dried in the air, passed into dilute sulphuric acid at 2 per cent, washed and dried.—*Chemisches Centralblatt.*

Manufacture of Chlorine by Deacon's Process.—C. Jurisch.—The author examines the causes which interfere with or hinder the production of chlorine in Deacon's process. Like M. Hasenclever he arrives at the result that the perturbations observed are due to sulphuric acid, but whilst Hasenclever ascribes this influence to a chemical action the author pronounces it chiefly mechanical, the balls of clay becoining coated with an inert layer. He points out that the proportion of hydrochloric acid decomposed depends on three factors:—(1.) The proportions of the mixture of air and hydrochloric acid gas. (2.) The rapidity of the gaseous current. (3.) The temperature of the gaseous mixture and of the balls of clay. The proportion of hydrochloric acid in the gaseous mixture varies from 20 to 60 per cent. Mr. Hurter has found that, other conditions being equal, the relative quantity of hydrochloric acid decomposed diminishes with the proportion of air, and increases with the dilution of the hydrochloric acid. The quantity of hydrochloric acid decomposed is the greater the slower is the gaseous current. The decomposition of hydrochloric acid augments with the rise of temperature.—*Dingler's Polytechnisches Journal.*

Dyeing with Aloes.—V. Preston.

Black Dye for Cloth.—V. Preston.—These receipts are not of general interest.

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THE CHEMICAL NEWS.

Vol. XXXVI. No. 920.

ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 2.)

172. Let me now carry the reasoning a step further. Experiments described in pars. 159 to 168 show that when heat of low refrangibility—from the body (159), the breath (160), hot air, or a warm glass shade (161, 165, 168)—falls on the white and black surfaces, the white is repelled more than the black, rotation of the radiometer taking place in the negative direction. The same rays falling on the two surfaces do more work on the white than on the black; and this, to my mind, appears sufficient to make it almost certain that the white pith absorbs more of these low rays than does the lampblack.

173. Let us imagine that surfaces of lampblack and pith are carried along the spectrum from the blue to the ultra-red. As long as they are in the visible portion we observe an enormous difference between them. In the extreme red we can actually see that this difference is becoming less. In my mind's eye I picture the progress being continued along the whole length of the ultra-red spectrum. I can see, by the light of the above-quoted experiments, that the absorptive action of the two surfaces gradually gets more equal. Soon they become identical in their action on the incident rays, and after that they enter a portion of the spectrum whose rays are no longer absorbed by lampblack, whilst they are quenched by the pith. Lampblack and pith have now changed places; the latter is black, whilst lampblack has become a white substance.

174. The normal rotation of the radiometer caused by dropping ether on it (163) is perfectly well explained by the above hypothesis. If heat in the act of absorption produces motion in one direction, in the act of radiation it produces motion in the opposite direction (167). Heat of low refrangibility falling on the radiometer repels the white more than it does the black, and produces negative rotation. When the same kind of heat is drawn out of the black and white surfaces by the chilling action of the ether, movement takes place in an opposite direction, and the arms rotate normally. On stopping this efflux of heat by covering the instrument with a hot shade (163), I changed the direction of movement by causing the surfaces to absorb instead of emit heat.

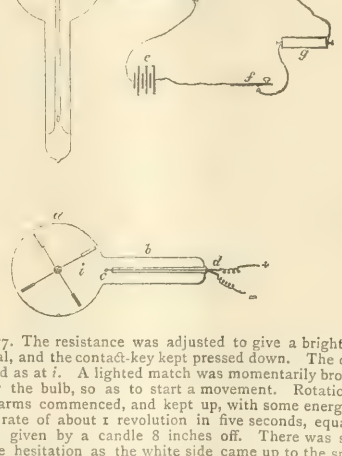
An irregular emission or absorption of heat (164) stops the movement altogether, for the reasons given in pars. 155 to 158.

175. I have made an apparatus by means of which I hoped to put the above theory to accurate test. The results are not so definite as they ought to be in order to settle the question; but they are worth giving in detail, as some novel facts have been elicited by them.

Fig. 10 shows the instrument; *a* is the bulb of a radiometer of the usual construction, having pith disks blacked on one side. *b* is a tube sealed into one side of the bulb, and having two stout platinum wires passing along it, sealed their whole length in glass to prevent leakage of air into the interior of the apparatus. At the ends *c* of the wires, a spiral of fine platinum wire is fastened, and the other ends (*d*) terminate in loops outside. *e* is a battery, *f* a contact-key, and *g* a resistance-coil, which I can vary at will. The bulb was perfectly exhausted, and the following experiments were tried:—

176. The resistance-coil was so adjusted that the battery would keep the platinum spiral (*c*) at a bright red heat. The arms of the radiometer, which were before quite still, moved rapidly until two of the disks were one on each side of the hot spiral, the black disk being further off than the white disk as shown at *i*. The resistance was then gradually increased, and as the temperature of the spiral diminished, the black disk gradually approached the spiral, until, when the temperature was just at the point of visible redness in a dark room, the black and white disks were practically equidistant from the spiral. On diminishing the resistance, the same phenomena took place in inverse order.

Fig. 10.



177. The resistance was adjusted to give a bright red spiral, and the contact-key kept pressed down. The disks stood as at *i*. A lighted match was momentarily brought near the bulb, so as to start a movement. Rotation of the arms commenced, and kept up, with some energy, at the rate of about 1 revolution in five seconds, equal to that given by a candle 8 inches off. There was some little hesitation as the white side came up to the spiral, but this was scarcely noticed when the speed had become steady.

The resistance was slightly increased. The speed became slower as the temperature of the spiral diminished, and the hesitation as the white approached the spiral became more apparent. The resistance was further increased, with the effect of making rotation still slower. I now brought the temperature of the spiral down to just visible redness in the dark. The speed of rotation again slackened; at each approach of the white surface to the spiral it stopped, hesitated, and then got past with a rush. Thus it went on for a few revolutions, until one white disk, a little nearer perhaps than the others, was not able to pass, and the arms after a few oscillations came to rest, the black and white surfaces being, as near as I could judge, eqidistant from the hot spiral.

These results fully confirm those obtained in experiments 128 and 144, and I think justify the conclusions arrived at in my discussion of them at par. 171—that at temperatures between 250° and 100° the repellent action of radiant heat is about equal on black and on white surfaces.

178. I now wish to ascertain whether the continuation of the reasoning (172) was correct—whether at temperatures lower than 100° C. the white would be repelled most.

* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

The resistance of the coil was increased again, and the position of the arms in respect to the spiral noticed. When so much resistance was offered to the passage of the current that the spiral would only be just warm, I fancied that the white set further from it than the black; but the observation was not satisfactory at higher temperatures; up to visible redness the repulsion was equal for each.

The breath sent the arms rapidly round the negative way (160).

179. The battery was disconnected from the instrument, and one end of a wire was attached to one of the platinum hoops, *d*, the other end of the wire being connected to the prime conductor of a frictional electrical machine. A few turns of the handle sent the arms flying about wildly; sometimes they spun round violently in one direction, then they stopped and went round the other way, finally one pointed steadily to the platinum spiral and refused to move. A candle was brought near, and all means were tried to discharge the disk, but with no effect. When the candle was quite close it overcame the interference, and the disks revolved in an irregular jerky manner.

The spiral was ignited by a battery, in the hope that this would discharge the electricity, but with no avail, and there was nothing to be done but stop the experiments and put the apparatus in water.

In three or four days the electrical disturbance was sufficiently diminished to enable me to proceed experimenting; but I could detect the influence for weeks after.

180. One pole of a small induction-coil capable of giving half-inch sparks in air was fastened to the platinum loops *d*, the other pole being held by an insulating handle. The loose pole was then brought near the bulb. The nearest disk rushed round to it and followed it a little, then it stuck as if the glass were electrified. By gently moving the loose pole round I could get the arms to rotate in either direction with a little practice, and they would keep on for five minutes or more when once started. It seemed a matter of indifference whether the black or the white surface went first. The results with the induction-coil were only a little more under control than those with the friction machine. The movements appear all to be explained by the known laws of static electricity; the rotations have no connexion with the instruments under the influence of radiation, but are of the "electrical fly" kind (34, 35 36).

FIG. 11.

181. Before leaving the subject of the radiometer, it may be of interest if I describe a few forms of this instrument which I have made for special purposes.

It is easy to get rotation in a radiometer without having the surfaces of the disks differently coloured. A radiometer was made similar to the one described in par. 152, but somewhat larger, and having the pith disk lampblacked on both sides. Its weight was 1·25 gra in It was exhausted with a charcoal-tube attached. When it was exhausted and a candle was brought near it, the arms moved until two of the disks were equidistant from the flame, and no amount of initial impulse in one or the other direction would set it in rotation. A piece of ice caused it to move until one disk pointed to the ice, when it also stopped. By shading the candle with a screen, so that the light shone on only one half of the fly, rapid rotation commenced, which was instantly stopped, and changed into as rapid rotation in the opposite direction, by altering the position of the screen to the other side.

182. It is difficult to exhibit the movement of a radiometer to any large number of people at once. To enable me to do this I have made an instrument, the disks of which are thin glass, silvered and polished on one side, and coated with lampblack on the other. This, owing to its great weight (65 grains), is somewhat slow; but in the sun, or with the electric light shining on it, the movement is very striking, as it shows four disks of light chasing each other round the room.

183. A radiometer was made of the following construction (fig. 11). *a* is the disk of pith, black on one side; it is attached to a thin brass arm revolving on a needle-point; *b* is a mirror, seen in section, hanging from the other side of the brass arm, and having its plane perpendicular to the plane of the pith disk *a*. The needle-point works in a jewel cup *c*, and is prolonged upwards into the tube *d*, which is sealed into the bulb, and in which the needle fits loosely. Behind the mirror *b* is a very small magnet, to give direction to the arm. The object of having the upper tube (*d*) is to prevent the arm from coming off in carriage: with the four, or more, armed radiometers it is easy to get the movable part on when it falls off, but with this one-armed instrument it would be an almost impossible feat. (This artifice of an upper protecting tube is one I have had occasion to adopt on many occasions, and I find it very convenient). The moving part weighs 2·42 grains; it revolves somewhat slowly when a candle is brought near, owing to the interference of the magnet. When the magnet is rendered nearly astatic by another magnet near it, and an index ray of light is reflected from the mirror, this radiometer is sensitive to a candle several yards off. It is a more convenient instrument for measuring different kinds of radiation than is the one on a similar principle described in par. 135, but, owing to the friction on the needle-point, it is not so sensitive.

184. A large radiometer in a 4-inch bulb was made with ten arms, eight of them being of brass, and the other two being a long watch-spring magnet. The disks are of pith, blackened on one side. The weight of the fly is 11·87 grains. This moves very rapidly for so heavy an instrument. The power of the earth on the magnet is too great to allow the arms to be set in rotation, unless a candle is brought very near; but once started it will continue to revolve with the light some distance off. This was made to enable me to communicate motion from the interior of the bulb to the outside. By suspending a magnet near the bulb, it oscillates to and fro with every revolution of the radiometer. The movement can thus either be projected on a screen or it may work a telegraphic instrument, and thus give a visible demonstration or a permanent record of the revolutions caused by any source of light under examination. As a self-registering photometric instrument this form of radiometer would be of considerable value.

185. A large six-disk radiometer was made in a 4-inch bulb. Immediately over the needle support a silvered glass mirror was fixed almost, but not quite, horizontal. By throwing a beam of light vertically downwards on this mirror it is reflected upwards at a slight angle, and as the radiometer revolves the movement can be seen by an audience as a spot of light traversing in a circle around the ceiling. The effect of various lights, coloured screens,

&c., in modifying the rapidity of movement can be well illustrated in this manner.

In a subsequent paper, which I hope soon to have the honour of laying before the Society, I propose to give the results of my experiments on the different rays of the solar spectrum, on the action of light and heat on various surfaces other than black and white, and on some attempts I have made to measure the force of radiation.

To be continued.)]

ANALYSIS OF BOILER INCRUSTATIONS.

By EDWARD FRANCIS.

A BOILER manufacturer of this town lately placed in my hands for analysis three apparently very dissimilar boiler deposits.

1. A brown cake, half-an-inch thick, from a small egg-end boiler, using water drawn from the south-west face of the Anticlinal of Brimington in the middle coal measures. The incrustation was hard, only partially soluble in H Cl (the solution being red), and nearly completely soluble in Aqua Regia.

The complete analysis shows—

Calcium sulphate	75·65
Silica	5·64
Ferric oxide	4·71
Magnesic oxide	4·85
Loss on ignition (water and organic matter)	8·61
Phosphoric acid	trace
Sodium and potassium	trace
	99·46

2. A very light grey cake, about three-eighths of an inch thick, readily pulverised, a portion taken up by water. This was obtained from a boiler fed by water from the Sheffield Water Company's Mains. The aqueous solution contained CaMg and H_2SO_4. It was not entirely soluble in HCl, the solution being of a pale yellow colour. The subjoined analysis leads to the inference that the water used was permanently hard, and that it had little action upon the iron of the boiler.

Calcium sulphate	79·56
Calcium carbonate	5·05
Ferric oxide	1·53
Aluminic oxide	1·02
Magnesic oxide	5·34
Water and organic matter	7·75
Sodium and potassium	trace
Phosphoric acid	absent
	100·25

3. An extremely hard residue, three-eighths of an inch thick, taken from a tubular boiler at Heeley, near Sheffield, the water used being pumped from a well. It was very difficult to powder, but was entirely soluble in aqua regia. The cake in places showed minute specks of metallic iron; these were afterwards dissolved out by iodine solution. A large percentage of ferric oxide exist in this incrustation. The following is the complete analysis—

Calcium sulphate	37·06
Ferric oxide	38·98
Aluminic oxide	1·62
Organic matter and water	8·80
Magnesic oxide	10·36
Carbonic acid	2·58
Metallic iron	trace
Sodium and potassium	trace
	99·40

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RESEARCHES ON PSEUDO-PURPURIN:

A SEQUEL TO

RESEARCHES ON THE COLOURING-MATTERS OF MADDER.

By M. A. ROSENSTIEHL.

I HAVE already shown that pseudo-purpurin heated to 180° evolves carbonic acid, and leaves a residue consisting of purpurin. This decomposition would lead to the formula $C_{15}H_8O_7$. The figures given by analysis do not agree exactly with those indicated by calculation, and I have put forward the opinion that the difference may be due to the presence of purpurin in the product analysed.

The object of the present paper is to confirm this latter point, to give the percentage composition of purified pseudo-purpurin, and to describe some of its properties.

1. If we treat pseudo-purpurin with a hot liquid capable of dissolving purpurin alone, we are never certain whether the latter had pre-existed in the product, or whether it was the result of a decomposition. The use of solvents being thus interdicted, I have made use of tinctorial trials to solve the question. I have shown, in fact, that pseudo purpurin does not dye with mordants save in presence of distilled water, and that it is totally precipitated from the dye-beck by its equivalent of carbonate of lime, whilst under the same circumstances purpurin produces its maximum results in dyeing. Proceeding upon this basis it became easy to show that pseudo-purpurin, prepared according to the instructions of Schützenberger and Schiffert, still retains purpurin.

2. To render pseudo-purpurin more accessible to solvents I transformed it into a soda-salt by means of the carbonate. On treating the aqueous solution of this salt with an acid I obtained a finely-divided precipitate, which was stirred up in cold alcohol. The first portions were coloured brown, the subsequent ones red; the former contained purpurin, but the latter pseudo-purpurin, as I have proved by tinctorial experiments. For 100 grms. of matter I used about 20 litres of alcohol.

The analysis of the product dried *in vacuo* at 100° gave—

	Experiment I.	Experiment II.	Calculation ($C_{15}H_8O_7$).	Analysis by Schützenberger and Schiffert.
C	60·36	60·15	60·00	61·00
H	2·68	2·80	2·66	3·00

These results, if we consider the difficulty attending the purification of such bodies, are sufficient to establish the formula $C_{15}H_8O_7$, which agrees perfectly with the decomposition which I have observed.

To satisfy myself that the latter is well-defined, and answers to the equation—

$$C_{15}H_8O_7 = CO_2 + C_{14}H_8O_5,$$

I executed a combustion divided into two stages: in the former the portion of the tube containing the compound was only heated to 180°, whilst a slow current of pure air traversed the apparatus; the result was 14·9 of carbonic acid in place of 14·6 required by calculation. The combustion of the fixed residue gave—

	Experiment.	Calculation ($C_{14}H_8O_5$).
C	65·32	65·62
H	3·16	3·12

The experiment agrees perfectly with the formula—

$$C_{15}H_8O_7,$$

which I have assumed as definitely established. It contains the following groupings:

$$C_{12}H_4C_2O_2(COHO)(HO)_3.$$

Pseudo-purpurin, therefore, is an acid comparable to the salicylic, which also by the action of heat is resolved into

carbonic acid and phenol. Nevertheless I have not succeeded in producing it, as has been done with the latter, by the action of carbonic acid upon the alkaline derivative of purpurin. I am continuing this investigation synthetically.

3. I have obtained pseudo-purpurin, crystallised in large brilliant laminæ, on exposing to the air the solution of its soda-salt in a mixture of water and alcohol.

4. On treating it, either dissolved in alkalies or in concentrated sulphuric acid, with reducing agents, there is formed an unstable addition-product which dyes with aluminous mordants and yellow-orange shade. On exposure to the air it gradually reverts to the state of pseudo-purpurin; in an alkaline solution this change is more rapid. This product, which I was unable to analyse on account of its instability, appears interesting because it possibly represents the state in which pseudo-purpurin exists combined with a saccharine body in madder. We know, indeed that the plant contains the tinctorial matters in a soluble, but slightly coloured, condition. It is only on prolonged exposure to air, during which a process analogous to fermentation is set up, that the tinctorial properties are developed.

5. It is important to observe that the remarkable instability of pseudo-purpurin is a fortunate circumstance, since neither it nor alizarin would have given to any plant the importance of madder.

The former of these compounds is too fugitive a tinctorial substance, and the reds yielded by the latter are deficient in brightness. The production of purpurin in industrial procedures corrects at once these two defects: the pseudo-purpurin is replaced by a compound yielding fast colours, the tone of which mingling with that of alizarin gives it that brilliance on which its commercial value depends.—*Comptes Rendus.*

ON IRON AS A NATURAL CONSTITUENT OF WINES.

By C. R. ALDER WRIGHT, D.Sc. (Lond.).
Lecturer on Chemistry in St. Mary's Hospital Medical School.

That iron sometimes exists in the ash left on evaporating wines to dryness and incinerating the residue has long been known; but in many cases it is not so certain as to how far this iron was pre-contained in the grape-juice employed, and how far it was derived from substances added to the wine during the process of manufacture—notably from gypsum used in the "plastering" process adopted in some cases, or from impurities in the glucose, &c., added to the grape-juice so as to obtain a larger alcoholic yield. The wine employed in the following experiments was obtained direct from Messrs. Auld, Burton, and Co., of the Auldana Vineyards, South Australia, and 8, Mill Street, Hanover Square, W. It had been grown and made under the superintendence of one member of the firm in Australia, imported in cask, and bottled in the London stores of the firm, so that, not having passed through the hands of agents, its genuineness and freedom from sophistication were as well guaranteed as such matters can be.

The following numbers represent the analytical figures obtained with two varieties of Auldana wine, distinguished as "Ruby" and "White." The alcoholic strengths are necessarily only close approximations, as each wine was heavily charged with volatile compound ethers, imparting a marked and peculiar bouquet, and communicating to the wines a higher exhilarating effect than that simply due to the actual alcohol present. It is noteworthy that the sulphates present are very low, and in less quantity than the potassium bitartrate, which indicates that no plastering had been adopted in either case, whilst the low percentage of grape-sugar shows that the fermentative process had been carried out very completely.

The numbers represent the grammes of each constituent per 100 c.c. (or grains per 100 fluid grains).

	Ruby.	White.
Sp. gr. at 60° F.	0·9874	0·9884
Alcohol and volatile compound ethers	10·500	12·000
Grape-sugar	0·207	0·248
Anhydrous sulphuric acid (SO_3)	0·043	0·048
Do. phosphoric acid (P_2O_5)	0·020	0·023
Chlorine (Cl)	0·015	0·015
Silica (SiO_2)	0·007	0·008
Potassium bitartrate*	0·123	0·136
Potash (K_2O) in other conditions than as bitartrate	0·127	0·106
Soda (Na_2O)	0·026	0·023
Ammonia (NH_3)	0·007	0·010
Lime (CaO)	0·016	0·014
Alumina	traces	traces
Magnesia (MgO)	0·025	0·027
Protoxide of Iron (FeO)	0·001	0·001
Volatile acids (calculated as acetic acid)	0·214	0·108
Glycerin, dextrin, tannin, vegetable acids, &c.	2·375	2·657
Water (by difference)	86·294	84·576
	100·000	100·000
Total solid constituents	2·992	3·316
Total free acid (calculated as tartaric acid	0·704	0·652
Total potash present (K_2O)	0·158	0·140
Matters left on in incineration:—		
Alkaline portion calculated as K_2CO_3	0·131	0·089
Neutral substances soluble in water	0·150	0·143
Matters insoluble in water	0·060	0·076
Total	0·341	0·308

Containing of K_2O: Ruby, 0·031; White, 0·034.

The determination of the state in which the iron present existed being of some interest, the following experiments were made, a large bulk of wine being employed (upwards of 10 litres of each kind):—

Determination of total Iron present.—Known bulks were evaporated to a syrup and charred; the matters soluble in water were dissolved out and the residue burnt white; finally, the total iron in the aqueous solution and ashes jointly was determined; amongst other processes, colorimetric tests—by comparison in Nesslerising cylinders with a weak standard iron solution, by means of ferrocyanide of potassium—were employed, and with fairly satisfactory results. The numbers deduced from several accordant observations gave the following average amounts, the iron being calculated as FeO:—

Ruby.	White.
0·00130	0·00130

each wine containing sensibly the same amount of iron.

That the iron was not present as a salt of the peroxide was evident from the circumstance that each wine contained œnotannin, striking a bottle-green tint with ferric salts; moreover no ferric reaction could be obtained with ferro- and sulpho-cyanides. On the other hand, ferricyanides gave on standing a blue precipitate in each case, showing the presence of soluble ferrous salts. In order to see if iron in other forms of combination (*e.g.*, analogous to blood-hæmatin) was present, known large bulks of wine were precipitated by acetate of lead, whereby almost complete decolorisation ensued; the precipitates were well washed, dried, and incinerated, the lead separated from the nitro-hydrochloric solution of the ashes by pure sulphuric acid, and the iron in the filtrate deter-

mined colorimetrically. In this way the following numbers were obtained :—

	Ruby.	White.
Iron in lead precipitate (calculated as FeO)	0·00060	0·00020

Hence it would seem that in the case of the ruby wine nearly one-half of the total iron present was carried down in the lead precipitate, whilst in the white wine only about one-sixth was thus precipitated. The experiments described below, however, indicate that the iron thus precipitated must have been carried down by a kind of mordanting action with the colouring-matter, more being of course thrown down with the most coloured wine, and not that the iron was really an integral part of the colouring-matter itself.

To see if any colloid iron compound was present, the wines were dialysed through clean bladders immersed in about 5 parts of distilled water for 1 part of wine. Every day or two days the water was changed. For the first two or three changes much iron was contained in the diffusate, but it soon began to diminish, and after five changes the diffusate only contained very small quantities of iron. The residual fluids in the bladder were then evaporated to dryness, and the residues incinerated and the iron determined. In this way there was found—

	Ruby.	White.
Iron remaining in bladders after ten days' dialysis (calculated as FeO)	0·00018	0·00016
Iron originally present	0·00130	0·00130

So that 86 per cent of the iron had dialysed away in the case of the ruby, and 88 per cent with the white wine. The small residual amount doubtless was due to the dialysis not being carried to the absolute limit.

A clear proof that the iron contained was practically wholly present as a salt of the protoxide was furnished by determining the amount of iron contained in the blue precipitate thrown down by ferricyanide of potassium, on standing and after washing. The quantities thus obtained (after deducting the iron in the precipitate due to the ferri-cyanogen) were—

	Ruby.	White.
Iron precipitated by ferri-cyanide (calculated as FeO)	0·00146	0·00146

The excess thus found over the total iron previously obtained (0·00130 in each case) is doubtless due to loss of a little iron during the incineration process, and other experimental errors.

On examining the analytical figures given above it is manifest that the potash and soda of the wines are in greater quantity than would suffice to neutralise the sulphuric and phosphoric acids and the chlorine, so that the ferrous oxide present can hardly have been contained as an inorganic salt; nor could it have been present as a tartrate, since presumably the tartaric acid would be wholly contained in the form of potassium bitartrate, much more potash being present than corresponds to the cream of tartar obtainable from the wine by precipitation with alcohol and ether, and the wine being of acid reaction. Hence the iron must have been present as a ferrous organic salt, probably malate or acetate.

Two circumstances are noteworthy as connected with the presence of iron in what there is every reason to believe were samples of wholly unsophisticated wine: first, that contact of the grape-juice with ironwork of any kind is studiously avoided, the crushing of the grapes being effected by means of wooden rollers covered with felt, and the fermenting-vats, &c., being constructed of slate; secondly, that the soil of the Auldana vineyard is exceptionally ferruginous, the general petrological character of the district being decomposed clay-slate and limestone, with frequent deposits of ironstone. That iron is taken up from the soil by trees and vegetation generally, in minute quantity, is rendered certain from the constant occurrence of traces at least of that metal in the ashes of plants and vegetables of nearly all kinds; so that there is no inherent improbability, but rather the reverse, in the notion that the highly ferruginous soil of the Auldana vineyard, together possibly with climatic peculiarities, is the cause of the occurrence of iron in the finished wine. On the other hand, the circumstance that almost identical values were obtained with each kind of wine (the white being of 1872 vintage and the ruby of 1873) renders it improbable that the source of the iron is outside of the grape-juice; for the grapes used for each kind of wine are the same, the differences being that in the production of the ruby wines the skins are fermented with the juice, whilst in the manufacture of the white wine they are previously carefully removed, and that the maturation and refining are carried out under slightly different conditions as to temperature, &c.

It deserves notice that the Auldana wines, being thus apparently ferruginous from purely natural causes, and containing considerable amounts of phosphoric acid, are to some extent analogous to "lactophosphate of iron," "Parrish's Chemical Food," and the like; not improbably, therefore, they will be found valuable from a medicinal point of view as highly agreeable tonics.

REPORT

ON THE METHODS EMPLOYED IN THE

ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,

AND ON THE

MODE OF STATING THE RESULTS.*

(Continued from p. 270.)

From these experiments it appears that the employment of the processes of Fresenius and Frank, leads to results sensibly above the truth if a large excess of platinum be employed. The fact that in *all* the experiments the error is in the same direction, indicates that it is not due to defective manipulation. When only a slight excess of platinum is employed in the above methods, the results are decidedly better, but present greater differences among themselves, as if some other disturbing cause came into operation. This is notably the case with Frank's method, the error in only six experiments varying from 0·01 per cent to 1·07.

The results by Tatlock's method distinctly indicate a tendency to loss, but this is chiefly noticeable in the cases in which the proportion of sodium chloride was very high (50 per cent). In fact, four experiments with a mixture similar to that which usually occurs in practice (*i.e.*, 82 per cent KCl and 18 NaCl) gave results showing an error in *excess* of the truth varying from 0·09 to 0·20 per cent. The thirteen determinations by Tatlock's method show a maximum error of 0·40 per cent. In this experiment the quantity of material employed was *measured* in the pipette, and for several reasons this plan was found less trustworthy than the *weighing* of the solution used. With the view of ascertaining the cause of the loss observed in some cases by Tatlock's method in presence of a large proportion of sodium chloride, an experiment was made by treating a mixture of 30 milligrms. of KCl and 0·7 grm. of pure NaCl with 30 c.c. of the platinum solution (the usual quantity) and estimating the potassium in the usual way. By employing a small quantity of KCl it was thought that other errors of manipulation would be avoided, and that the experiment would be practically to ascertain the ex-

* Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

tent to which chloroplatinate of potassium was soluble in a solntion of platinic chloride containing much chloride of sodium (or, in other words, in a solution of sodium chloroplatinate). The weight of potassium chloroplatinate which should have been yielded by the above quantity of KCl is 0·0982 grm., whereas the weight actually obtained was only 0·0915 grm. Hence there was a loss of 0·0067 grm. In another experiment in which only 0·35 grm. of NaCl was used, the quantities of KCl and platinum solution remaining as before, a loss of 0·0042 grm. of chloroplatinate was observed. In this last experiment the potassium chloride corresponding to the chloroplatinate obtained was only 95·7 per cent of the quantity added, while in the previous experiment it amounted to 93·2 per cent. From these results, and those recorded in the tables, it appears that the percentage error is larger the greater the proportion of sodium salts present, a fact which appears to point to the solubility of the precipitate in solution of sodium chloplatinate as the origin of the loss. Thus, in the experiments in which pure chloride of potassium was employed, and in those in which the amount of sodium chloride was small, the variation from the truth was exceedingly slight, but the error became greater with the amount of sodium chloride present. In experiments 42 to 50 the amount of chloride of sodium and platinum solution employed were the same as in the test experiment in which a deficiency of 0·0042 grm. of precipitate was observed. If we assume that this loss is the weight of K_2PtCl_6 dissolved by the use of 0·35 grm. of NaCl and 30 c.c. of platinum solution, then a correction of 0·0042 grm. ought to be applied to each of the results of experiments 42 to 50. This correction of 0·0042 grm. in the weight of the precipitate corresponds to 0·37 per cent of KCl. The mean of the nine experiments above referred to is 99·58 per cent of KCl, which, with the correction 0·37, amounts to 99·95 per cent. From these considerations it appears almost certain that the deficiency is due to the solubility of the precipitate in platinum solution containing sodium chloroplatinate.

If a loss of about 4 milligrms. produces an error of 0·37 by Tatlock's method, the discrepancy would be much greater by Frank's, in which a smaller weight of the sample is employed. This fact, and the very strong alcohol required, render this process less satisfactory than that of Fresenius. Why the latter process should give results in excess of the truth, even when the modified method (II.) was used, seemed difficult to explain. With a view of ascertaining the cause, three quantities of pure chloride of potassium with equal weights of chloride of sodium, were treated by Method I. After weighing, the precipitates were dissolved in hot water, 10 or 12 drops of platinum solution added, and the process of evaporation, &c., repeated. The following results were obtained :—

TABLE VI.

			1st precipitation.			After re-dissolving.		
Experiment	Weight of Solution.	KCl taken.	Weight of Precipitate	= KCl. found.	KCl per cent.	Weight of Precipitate	= KCl.	= KCl per cent.
61	3·8530	0·35027	1·1542	0·35272	100·70	1·1527	0·35226	100·57
62	3·8725	0·35204	1·1606	0·35469	100·75	1·1615	0·35495	100·82
63	3·7770	0·35245	1·1618	0·35504	100·73	1·1609	0·35478	100·66

In these and in all previous experiments the precipitates were dried at 100° C.

In the last edition of his "Quantitative Analysis," Fresenius directs the precipitate to be dried at 130° C. To ascertain if this difference of treatment was the cause of the error, some pure potassium chloroplatinate was prepared by rapidly cooling a saturated solution of the salt in boiling water. In this way it was obtained as a fine crystalline powder. By the slow evaporation of the mother-liquor another sample was obtained in the form of "scales." The products were dried for half-an-hour at 100° C, and 3 grms. of each exposed to a higher temperature with the following results :—

TABLE VII.

	Crystals.		Scales.	
	Loss on 3 grms.	Loss per cent.	Loss on 3 grms.	Loss per cent.
After 1 hour additional at 100° C...	none	none	none	none
After ½ hour additional at 130° C...	0·0005	0·017	0·0015	0·005
After 1 hour additional at 140° C...	0·0015	0·050	0·0005	0·017
After ½ hour additional at 200° C...	0·0080	0·270	0·0075	0·250

It will be seen that no loss occured on further drying at 100° C., and a very trifling loss at 130°. After heating to 140° there was a slight change of colour. At 200° decrepitation and incipient decomposition ensued. The total loss at a temperature not exceeding 140° was only 0·067 per cent of the weight of the precipitate. This, in the experiments by Method I., would only cause a difference of 0·02 per cent on the quantity of chloride of potassium found. Hence it is clear that there is no advantage in drying the precipitate at 130° rather than at 100°. On the other hand the occurrence of decrepitation shows that the crystals contain cavities filled with water or platinum chloride solution, and therefore that the production of large crystals should be avoided. It seems possible that the difference in the nature of the liquid filling the cavities may be the cause of the greater error observed when a large excess of platinum solution is employed than when little more than the theoretical amount is used.

In the foregoing tables the results obtained by Frank's method were calculated with the Committee's factor 0·3056, instead of that employed by Frank and Berrand themselves (0·30507).* By the use of the latter factor the results would come out about 0·17 per cent lower than the figures given in the tables. Some of the results by this process are exceedingly good, but in other cases they are seriously in excess of the truth. (See Experiments 3, 4, 59 and 60.)

(To be continued.)

NOTES ON SPECIMENS OF CHRYSOCOLLA.

By W. M. HUTCHINGS.

On a former occasion (Chemical News, vol. xxxiv., p. 141) I communicated two analyses of chrysocolla and "kupferpecherz," made on specimens of the ore known in this country as "Mexican ore," which is mined, I am informed, in Lower California. Since then, having obtained many more very interesting specimens, I have made further analyses, some of which are, perhaps, of sufficient interest for publication.

Many pieces of the ore are found which consist of two very distinct varieties of chrysocolla, one part being hard, vitreous, and of a fine bluish green colour (exactly like the specimen formerly analysed), while another portion is soft and earthy, of a pale bluish white colour, so pale that it is often almost quite white, and is so light and porous that it will float for some time upon water—till it has absorbed sufficient to cause it to sink. This earthy variety is so soft that it can be cut easily with a knife, and can be scratched with the finger-nail. One specimen

* The factor employed by Frank and Berrand is based on Andrews's determination of the atomic weight of platinum. This observer states that potassium chloroplatinate retains 0·55 per cent of water even when dried at temperatures considerably above 100° C. If this be true the low factor employed by Frank and Berrand would partly compensate the error thus introduced. In the experiments detailed in the text, only 0·27 per cent was lost at a temperature of 200°, but further decrepitation occurred on raising the temperature still higher.

was found to absorb 85·5 per cent of its own weight of water, after which it had almost as deep a colour as the vitreous variety.

Dana mentions the occurrence of similar specimens, and gives an analysis by Scheerer, saying, "The chrysocolla analysed by Scheerer occurs with felspar, and is supposed to have resulted from the action of suphate of copper on the felspar. Some specimens of the chrysocolla are transparent and brittle on one part, and earthy, like decomposed felspar on the opposite." It is not stated on which portion of the specimen Scheerer made the analysis.

I have never found any felspar among this ore, and do not know whether they occur together at the mines. (So far as I am aware no description of these wonderful deposits has yet appeared anywhere; a mineralogical and geological report on them would be of the highest possible interest.) Many of the earthy specimens do certainly, in some respects, much resemble decomposed felspar in appearance.

I selected a large piece, weighing several pounds, of which about one half was vitreous, and the other half earthy, and after breaking off the outer portions, took samples of both varieties for analysis, the results being as follows:—

The finely-powdered minerals were dried at 95° C. for some hours.

	Vitreous.	Earthy.
Total silica	67·07	46·45
Copper oxide	24·95	39·15
Lead oxide	0·26	0·41
Ferric oxide	0·27	0·48
Alumina	0·55	3·65
Zinc oxide	0·09	0·10
Lime	0·81	0·80
Magnesia	0·37	0·82
Water	5·82	7·99
	100·19	99·85

The specimens contain also traces of cobalt and manganese and small amounts of P_2O_5.

The difference in composition is sufficiently striking. The presence of alumina in both varieties, and its much larger amount in the earthy one is very noteworthy, as no alumina is found in specimens from large pieces on which none of the earthy chrysocolla occurs.

The mineral of these deposits is doubtless "true chrysocolla" (if, indeed, any definite composition can be singled out as representing a normal chrysocolla), mixed with large amounts of opal silica, the proportion of this latter varying very much, but remaining pretty constant in specimens which are alike as to colour, hardness, &c. The proportions of the chief constituents of the vitreous mineral, as above, do not differ very much from those of my former analysis.

There is also a certain amount of silica very finely disseminated through the mineral as quartz and chalcedony. It would be interesting to know the proportion of this; and in specimens which contain no alumina, and but little lime and magnesia, the determination can be made with some approach to a curacy, as the silica separated by long digestion with strong HCl is almost perfectly pure, dissolving easily in moderately-concentrated solution of Na_2CO_3, leaving a residue consisting almost entirely of sharp, gritty, transparent or white grains. But when alumina is contained, pure silica is not obtained by HCl, and a similar determination of the quartzy silica is not practicable. In the above analyses I can only roughly estimate it to be about 3 per cent in the vitreous, and less than 1 per cent in the earthy variety.

The earthy chrysocolla is more or less fusible, apparently owing to the increase in alumina. Its composition seems to vary somewhat, even in small homogeneous-looking specimens, as bits chipped off one portion are easily fused to a ball before the blowpipe, while bit from another portion can only be sintered and rounded on the edges. The above analysis was made upon a sample of about 20 grms., chipped from various places on the one large specimen. The powder is not quite fusible; made into a little flat "cake" of paste with water, it can just be fused at the edges, the rest sintering together.

The vitreous mineral is not in the least degree fusible. It turns black at first, but on continued exposure to a strong oxidising flame it becomes red, probably from the formation of some cupreous silicate. The fusible mineral does the same at first, but when fusion or sintering has taken place the colour is dirty yellow.

Laboratory, Wallasey Ore Works,
Birkenhead, June 15, 1877.

In addition to the minerals of which I have already given analyses occurring in the chrysocolla-ore from Lower California, I have found a small quantity of what appears to be another variety of the "kupferpecherz." It has hardness of 2 to 3, black streak, and is very easily fusible before the blowpipe; differing in these respects from the variety formerly analysed (Chemical News, vol. xxxiv., p. 141). I have found it only in thin layers, alternating with chrysocolla and fibrous gypsum. Its composition is as follows, the powder being dried previous to analysis at 95° C.:—

	Per cent.
Silica	11·95
Copper oxide	14·20
Ferric oxide	9·35
Zinc oxide	0·80
Cobalt oxide	0·95
Manganous oxide	38·5
Oxygen	7·89
Lime	2·41
Magnesia	2·35
Sulphuric anhydride	0·16
Water	11·61
	100·20

June 25, 1877.

ON THE

PRESENCE OF OCCLUDED OXYGEN IN STEELS, ESPECIALLY IN BESSEMER STEEL.

By SERGIUS KERN, St. Petersburg.

Engineers making cast steel by the Bessemer process know very well the following two facts:—

1. That on adding to the metallic bath in the converter melted spiegeleisen a very high flame rises from the mouth of the apparatus, which is, first, of a very white colour, and next gradually changes, the flame becoming crimson when all the spiegeleisen has been poured in and the retort is turned to the casting ladle. It must be mentioned that during all this time there is no blowing through the apparatus, so that no abundant quantity of oxygen can be supposed to be present in the apparatus, however the flame mentioned above is of a very oxidising character.

2. As the metal in the apparatus is thoroughly decarburised, which may be easily ascertained by the spectroscope, and as the percentage of carbon in the spiegeleisen coming from the cupola may be strictly determined, it is evident that the percentage of carbon in the obtained steel may be very easily and exactly predicated. However, in the resulting steel a lower percentage of carbon is always found than ought to be, according to the calculations of the metallurgist; but a higher percentage in this case was never determined—certainly in this case the process must be very accurately executed.

This is still an open question in metallurgy. Leaving to the metallurgists the study of these interesting facts, I merely mention here that some chemists explain this metallurgical point by the occlusion of oxygen in melted steel, and some of them tell us that even solid steel contains oxygen in very minute quantities.

At the moment when the spiegeleisen is added to the metallic bath, a certain quantity of the carbon which it contains combines with the occluded oxygen, forming carbonic oxide (CO), which flies away, giving to the hot gases coming out from the retort a crimson tint; indeed, carbonic oxide burnt in sufficient quantity, imparts to the flame a crimson tint. In such a case, when a certain quantity of carbon is burnt, the resulting steel must contain less carbon than was expected.

In order to ascertain the presence of oxygen combined with the steel in the metallic bath of the Bessemer apparatus before the addition of spiegeleisen several experiments were made. As no special method for the determination of oxygen in steels could be found in manuals of analytical chemistry, a very easy method was devised which, noticed here, may be of some use to chemists for further experiments:—

100 grms. of the steel in pieces weighing 10 to 15 grms. are placed in a platinum or porcelain combustion tube, connected with a potash apparatus containing a freshly prepared concentrated solution of pyrogallic acid—

$$[C_6H_3(HO)_3]$$

in potassium hydroxide. The potash apparatus before the experiment is carefully weighed on a delicate balance. Next the combustion tube is gradually heated to a high temperature. In the same time through the tube and apparatus nitrogen is passed, obtained by the decomposition by heat of ammonium nitrite (NH_4NO_2). Before passing this gas through the apparatus it is well dried by calcium chloride. The ignition of the steel in the tube must be continued for an hour, and next the apparatus is gradually cooled; the nitrogen meanwhile is also freely passed in order to avoid oxidation. The potash apparatus is next quickly weighed. The increase in weight of the apparatus will show the quantity of oxygen present in steel.

Experiments proved the existence of oxygen in very moderate quantities. Thus five specimens analysed gave 0·054, 0·037, 0·025, 0·040, 0·031 per cent of oxygen.

It would be of great interest if chemists undertook experiments in order to work out this question. My opinion is that in this case the oxygen is in an occluded state with steel, and even forms a certain chemical compound, very unstable, however, when heat is applied. It may be analagous to hydrogen palladium (Pd_2H), which, by some chemists, is regarded as a chemical compound, and by others as a simply mechanical compound of palladium and hydrogen, the latter being only occluded in the metal.

Obouchoff Steel Works.

PROCEEDINGS OF SOCIETIES.

RUSSIAN CHEMICAL SOCIETY, ST. PETERSBURG.

May, 1877.

A. WISCHNEGRADSKY, "*On the Isomery of the Amylens.*" (Second paper). The author concludes the account of his researches on the amylen resulting from the action of alcoholic potash on amylic iodide, showing it to consist of a mixture of two hydro carbons.

W. ALEXEYEFF, "*On the Reciprocal Solubility of Phenol and Water and of Amylic Alcohol and Water.*" The experiments were conducted by sealing weighed amounts of the substances in a glass tube and ascertaining at what temperature they united to form a clear solution. The solubility of phenol in water increases at first in direct ratio with the temperature, then more rapidly, until at 81° it is soluble in all proportions. As no alteration in the increase of solubility takes place at the fusing point of phenol, it is considered that a change in the state of aggregation of a substance does not affect the solubility. The solubility of amyl alcohol in water decreases until a minimum at 50° is reached, and then ascends gradually. These facts are regarded as being in consonance with the hypothesis that an increase of the solubility with the temperature takes place only in the case of such compounds as form either a stable hydrate or no hydrate.

G. GUSTAVSON, "*New Method of Introducing Bromine into the Aromatic Hydrocarbons in the presence of Aluminium Bromide.*" The author finds that by the slow addition of the aromatic hydrocarbons to an excess of bromide containing a small amount of Al_2Br_6, the complete replacement of the hydrogen atoms in the benzene skeleton,—although not in the side-links—is caused. The reaction is exceedingly violent, and must be performed in a cooling mixture. Benzene yields by this method, at 0°, C_6Br_6 quantitatively; toluen gives $C_7Br_5H_3$; and mesitylen is changed into the tribromomesitylen of Fittig and Storer. By reversing the process, adding a limited quantity of bromine to a solution of Al_2Br_6 in a hydrocarbon, any desired number of hydrogen atoms can be substituted. The method is a vast improvement on that hitherto used, of exposing the hydrocarbons to the action of Br and I at 400° for a length of time.

A. ELTEKOFF, "*Structure of the Amylen boiling at 25°.*" The experiments of Wischnegradsky showing this to be a mixture of two amylens, have been confirmed by changing them into bromides, and submitting the latter to the action of alcoholic potash. The results are valenylen boiling at 35°, and ethyl-valeryl-oxide, the latter of which could only be formed from the unsymmetrical melhyl-ethyl-ethylen.

I. SETSCHENOFF, "*Absorption of CO_2 by Blood.*" The chief results of the author's investigations are the following:—1. The serum of blood possesses a coefficient solubility for CO_2, not far removed from that of water, and can be considered, in that regard, as a weak solution of phosphate or carbonate of soda. The quantities of CO_2 absorbed are, however, much more dependent on temperature and pressure. 2. The alkalies decomposed by the CO_2 are albuminates containing paraglobuline. 3. The red blood cells possess a much greater coefficient of solubility than water. It is, however, much more affected by variations of temperature and pressure than that of serum, and these variations affect inversely the amounts of merely dissolved and of chemically combined CO_2. 4. CO_2 is found in all cases in both serum and cells, the normal saturation in the veins corresponding to the absorption at 37° and 50 m.m. pressure.

CORRESPONDENCE.

BISCHOF'S PAPER ON PUTRESCENT ORGANIC MATTER IN POTABLE WATER.

To the Editor of the Chemical News.

SIR,—Bischof's paper, which you quote from the *Proceedings of the Royal Society*, is deficient in novelty, and calculated to make an erroneous impression. The substance of the communication in question is that a certain kind of porous filter removes organic matter from drinking water with great completeness, and that animal charcoal does not.

Neither of these facts are new, and persons who are conversant with modern researches on filtration will be apt to ask, why was such a communication made to the Royal Society?—I am, &c.,

J. Alfred Wanklyn.

Laboratory, 117, Charlotte Street, Fitzroy Square, London, W., July 7, 1877.

NOXIOUS INSECTS: THE STAMPING-OUT PROCESS.

To the Editor of the Chemical News.

Sir,—The subject of insect and germ life in its relation to putrefaction and infectious disease is now assuming such importance from the investigation and demonstration of Dr. Tyndall, Mr. Murray, and other scientific inquirers, that I think you may consider the following curious facts not unworthy of space in your journal.

I observe in a report of Dr. Tyndall's lecture on "Germs," in the *Times* of Saturday, June 9, he refers particularly to the varying tenacity of life which germs under certain conditions exhibit, and which he refers to the period of incubation, or stage of development up to the state of emergence as complete organisms, when they are readily destroyed. He says, "We now turn to another aspect of the question. Following the plain indications of the germ theory of putrefaction, we sterilise in five minutes the very infusions which, a moment ago, were described as resisting five hours' boiling.

"The germs are indurated and resistant; the adult organisms which spring from them are plastic and sensitive in the extreme. The gravest error ever committed by biological writers on this question consists in the confounding of the germ and its offspring. The active bacteria developed from those obstinate germs are destroyed at a temperature of 140° F. Let us reflect on these facts.

"For all known germs there exists a period of incubation, during which they prepare themselves for emergence as the finished organisms which have been proved so sensitive to heat. If during this period, and well within it, the infusion be boiled for the fraction of a minute, even before the boiling-point is reached at all, the softened germs which are then approaching their phase of final development will be destroyed. Repeating the process of heating every 10 or 12 hours, each successive heating will destroy the germs then softened, until after a sufficient number of heatings the last living germ will disappear. If properly followed out the method of sterilisation here described is infallible; a temperature, moreover, far below the boiling-point suffices for sterilisation."

Now, as the laws of Nature apply to all magnitudes alike, whether it be a grain or a planet, whether to the various stages of incubation of the germs of bacteria or of noxious insect life, I think I may claim some credit for having stumbled upon, and for having applied on a practical and large scale, a system for eradicating insect life in animals, based on this law of varying tenacity of life in germs and insects.

More than two years ago I advocated this system, and in September last issued the following circular:—

"To Flockmasters, Farmers, and Graziers.

"Gentlemen,—In a circular which I issued some time since, I ventured to give a few suggestions on what I and others considered should be the right rules to be adopted in the important matter of cleansing sheep from noxious insect life, and at the same time I stated that I believed, by systematic treatment, much of this insect contagion might be stamped out. I will now briefly give my own experience, derived from the management of a flock of between 600 and 700 old sheep and lambs.

"A short time after clip-day, I dipped by immersion the young lambs, and I repeated the same before harvest. At the same time I made a long narrow pen alongside the stackyard fencing, into which I crammed all my old sheep as close together as possible. I then, with an ordinary warering-pan, watered then all over with diluted fluid; the latter operation was completed in half-an-hour, and the cost in material was less than ½d. per head, the proportions in both cases being 1 to 100. Now for results. Only yesterday I minutely examined the whole of my sheep, for the purpose of deciding if it was necessary to give then a final dressing before October; and I can now, frankly and without hesitation, state that in the whole flock, old and young, I could not find a single living insect, or the germ of one, although at the same time last year, in consequence of using the old-fashioned arsenical material, my sheep swarmed with filth. I shall now, of course, let well alone, under the conviction that my sheep will keep perfectly clean up to next clip-day; at all events I shall closely watch them, and whatever the results may be I will again trespass on your attention by a candid statement of facts. To sum up, it would appear that the correct system is to kill the present generation of insect life, and about a month or six weeks after, when their eggs have germinated, to attack the rising generation, and thus 'stamp them out' altogether."

In the month of March last, agreeable to my promise, I issued a faithful report of the results of this system for stamping out insect life, which I enclose, but in case it should be too long for your valuable space, I may briefly say my hopes were completely realised, every insect pest was stamped out; and hundreds of persons inspected my flock, which was absolutely clean.

I believe I may say there is exact analogy between this system for exterminating insect life in animals and that adopted by Dr. Tyndall, to show that the earliest eggs or germs of bacteria are extremely obstinate to kill, whilst the fully developed are destroyed without difficulty; clearly showing that more than one treatment is necessary for the complete destruction of germ life as well as for a higher form of insect life, and that the same law applies to both alike.

I am fully convinced of the possibility of stamping out noxious insects that affect sheep and other animals, and sincerely hope Mr. Murray's suggestion at the Society of Arts—of united action to effect this purpose, under the direction of science and experience—may be acted upon with little delay.—I am, &c.,

W. Little.

The Hall, Heckington, Lincolnshire.

P.S.—I shall be glad to send the report to any of your readers who may desire to see it.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 24, June 11, 1877.

Densities of Vapours; a reply to M. H. Sainte Claire Deville.—M. Ad. Wurtz.

Atomic Notation; a reply to M. Berthelot.—M. Ad. Wurtz.—These two papers are further contributions to the controversy which has now been raging for some time between this author and the two distinguished chemists above-mentioned.

Rotatory Polarisation of Quartz.—MM. J. Soret and E. Sarasin.—The authors have previously communicated

to the Academy the results of their researches on the rotatory polarisation of quartz for the different rays of the solar spectrum from the ray A to R. They have now extended their investigations to the ultra-violet rays of a still greater refrangibility.

New Electric Lamp with Oblique Circular Rheophores.—M. E. Reynier.—The author's object has been to produce an electric lamp capable of acting for 24 hours. He has succeeded in almost completely suppressing the occultations hitherto supposed inherent in the use of dics. M. Cance submitted to the Academy a novel system of electro-magnets with a mutiple nuclei, analogous to that of M. Camacho, but in which the tubular nuclei are replaced by series of small rods of soft iron in juxtaposition and enveloping in pairs the different layers of spirals.

Use of Electro-Magnetic Machines with continuous currents.—M. Gramme.—The author infers from his experiments that in electro-metallurgical operations it is more economical to arrange the baths for tension than for quantity. M. Jamin on presenting M Gramme's paper remarked that M. A. Thenard had previously communicated experiments proving that the total amount of copper deposited by a Gramme machine is increased considerably by directing the current through a series of baths whilst the sum of the deposits remains sensibly constant when the baths are arranged not for tension, but for quantity.

Influence of a Mechanical Action on the Production of Various Hydrates in Supersaturated Solutions.—M. D. Gernez.—The author finds that if a rigid rod is introduced into a supersaturated solution, or rubbed against the sides of the vessel below the level of liquid, the formation of crystals may be determined. M. Gernez specifies three cases; crystals of the least hydrated salt may be produced, as when clear and very concentrated solutions of the sulphate of soda below 8° are thus treated. Secondly, there are produced crystals of the most hydrated salt in solutions where, nevertheless, the other hydrate may be formed by the introduction of a crystalline germ. This takes places with the acetate of soda. Or thirdly, either hydrate may be produced according to the intensity of the mechanical action. This case has been observed in concentrated solutions of chloride of calcium.

New General Method for the Synthesis of Acetones, Hydrocarbides, &c.—MM. C. Friedel and J. M. Crafts.—The authors mix an organic chloride, iodide, or bromide with a hydrocarbon and add chloride of aluminium in small portions. Thus having mixed benzol with iodide of ethyl and added chloride of aluminium they obtained ethyl-benzol, boiling between 135° and 137°.

Researches on Normal Propylen.—MM. E. Reboul and E. Bourgoin.—The authors find that the electrolysis of pyrotartaric acid does not yield trimethylen, allylen, ethylen, or acetylen.

Composition of a Substance formed on an iron rod affected by the gases of a Siemen's Furnace.—M. A. Terreil.—The substance in questiou contains:—

Iron as protoxide	62·46
„ as peroxide	13 19
„ as sulphide	0·54
Oxygen	23·46
Sulphur	0·31
Silica	traces
	99·96

M. Daubree considered that this substance afforded fresh proof of the extreme permeability of solids, such as baked clay or crystalline ferrous oxide to gases, a property which may be applied to various geological facts, and especially to certain phenomena of metamorphism.

Bulletin de la Societe Chimique de Paris, No. 7, April 5, 1877.

Reduction of Mercury in California.—M. Paterna.—The cinnabar is converted into calomel by the action of copper chloride; the calomel is dissolved in hyposulphite of soda, and sulphide of mercury is then precipitated by sulphide of sodium. The process is tedious and costly. Sieverking describes another process in the *Mining and Scientific Press* of San Francisco. He places the ground ore in casks with granulated copper, or, preferably, an alloy of copper and zinc, and agitates the mixture for twelve hours with a hot solution of cupric chloride. When a sample taken out shows the total decomposition of the cinnabar, a small quantity of zinc amalgam is added which effects the precipitation of all the copper which has remained in solution and causes the agglomeration of that portion of mercury which had been deposited in a pulverulent state. The agitation is continued for some time; the casks are then filled with water and allowed to settle. The amalgam, which is very compact, subsides; the liquid is carefully decanted and distilled; the residue from this distillation serves for the preparation of chloride of copper for succeeding operations.

No. 8, April 20.

Reaction between Nitrogen and Water.—M. Berthelot.—The author has repeated with an affirmative result experiments on the formation of the nitrate of ammonia under the influence of the electric effluve. The result, however, cannot be produced under the influence of weak electric tensions.

Constitution of Salts and Acids in Solution.—M. Berthelot.—Not suitable for abstraction.

Influence of Pressure upon Chemical Phenomena.—M. Berthelot.—The development of hydrogen by the action of dilute acids upon zinc is not assisted by pressure but merely retarded.

Transformation of Pyrotartaric Acid into Dibromopyrotartaric and Dibro-mosuccinic Acids.—MM. E, Reboul and E. Bourgoin.—Not suitable for abstraction.

Metal which accompany Iron.—M. A. Terreil.—Reserved for insertion in full.

Sulphide of Manganese.—MM. Ph. de Clermont and H. Quiot.—Already noticed.

Certain Amides of the Napthyl-Sulphurous Acids.—M. J. A. Carleson.—By the action of ethylamin, aniline and napthylamin upon the chlorides of the α-and-β-naphthyl-sulphurous acids the author has obtained α-and-β-ethyla-mide, α-and-β-anilide, and α-and-β-naphthylamide.

Reten-Sulphurous Acids.—A. G. Ekstrand.—Not adapted for abstraction.

Certain Compounds of Mercuric Cyanide with the Chlorides of the Earthy Metals.—M. J. E. Ahlen.—The salts in question have been obtained by allowing a solution of mercuric cyanide to crystallize along with an excess of the chlorides of cerium, lathanum, didymium, yttruim and erbium.

Molecular volumes of Isomorphous Salts.—M. O. Petterson.—The author has examined many double salts of the alum group, the sulphates and seleniates of the earthy metals.

A number of papers on organic chemistry, all taken either from *Liebig's Annalen*, or from the *Berichte der Deutsch. Chem. Gesell.*, and the technological notes which follow are all from the *Comptes Rendus*.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. May, 1877.

Report presented by M. Duméz on behalf of the Committee of Mechanical Arts, on an Electric Clock presented by M. de Laguerenne.

Report on the Improvements introduced by M. de Laguerenne in his Electric Clock.—M. Th. du Moncel.

These papers would be unintelligible without the accompanying figures.

Statistics of the Glass Trade.—M. H. de Fontaine.—The total annual value of the glass manufactured in Europe and America has almost doubled during the last twenty years, and amounts now to six hundred millions of francs.

On the Mines of Japan.—Taken from the *Quarterly Journal of Science.*

June, 1877.

This issue contains no original chemical matter.

Reimann's Färber Zeitung, No. 22, 1877.

The chemists employed by the sanitary authorities of Sweden are said to have used improper methods for the detection of arsenic in various dyed and coloured articles, such as woollen and cotton goods, lamp-screens, paper, confectionery, &c. As a large portion of the condemned articles are said to have come from Germany, the affair has led to a correspondence between the Swedish Department of Foreign Affairs and the German Ambassador. According to the Berlin papers a pianoforte manufacturer has died of blood-poisoning in consequence of having bound up a cut on his finger with a piece of leather dyed with Schweinfurt green!

Eosin.—A. Baeyer has given certain additional particulars as to the manufacture of eosin. Fluorescein is obtained by heating 5 parts of anhydrous phthalic acid to 200° along with 7 parts of resorein. The mass swells up and solidifies in the course of three to six hours. Fluorescein is extracted from this crude product by boiling with alcohol. It is a feeble acid, and dyes silk and wool a fast yellow with a reddish cast. For the preparation of eosin the fluorescein is suspended in 4 parts of glacial acetic acid and solution of bromine in glacial acetic acid, containing 20 per cent of the former is added. Tetrabrom-fluorescein (eosin) separates out in red crystals.

No. 23, 1877.

The property of zinc-powder of liberating an intense heat when moistened, has placed a ship, which contained a cask of this article in great peril of fire.

No. 24.

New Formation of Rosanilin.—Dale and Schorlemmer produce rosaniline by heating red aurin to 150° for several days along with ammonia. The details of the process are given in the *Berichte der Deutschen Chemischen Gesellschaft*, 1877, 10.

According to the *Bulletin de la Soc. Indust. de Rouen* Collin produces a soluble aniline black by heating together to 200° degrees for five hours; a mixture of 6 grms. oxalic acid, 5 grms. aniline, 2 grms. sulphate of iron, and 3 grms. nitrobenzol. The liquid dyes cotton a grey, and wool a black, deficient in intensity.

No. 25, 1877.

The extract of chestnut-wood is coming more widely into use as an astringent in dyeing and tanning.

Dr. Reimann still complains of the piratical conduct of a Belgian contemporary.

Les Mondes, Revue Hebdomadaire des Sciences, No. 5, May 31, 1877.

This issue contains no original chemical matter.

No. 8, June 21st, 1877.

A statue of Arago will soon be erected at Perpignon. The municipal council of Chalons is collecting funds to do homage in like manner to the memory of Niepce de St. Victor, and a statue of Ampere is in contemplation at Lyon.

Lighting with Resin.—M. Pallas considers that the use of the volatile essences distilled from resins depends upon the construction of a suitable lamp.

M. Berthrand and M. Guyot contribute papers on the excessive or imprudent use of tobacco, and on the presence of carbonic oxide in the products of its combustion.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JUNE, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2-foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Anhydrous Sulphuric hydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Turbid	0·001	0·008	0·129	0·050	18·40	7·500	0·360	0·94	1·660	11·0	4·2
West Middlesex	Clear	0·000	0·007	0·129	0·054	17·70	7·280	0·320	0·94	1·600	12·6	3·3
Southwark and Vauxhall	Turbid	0·001	0·009	0·108	0·064	18·90	7·720	0·360	0·87	1·730	12·6	3·0
Chelsea	Clear	0·002	0·009	0·090	0·076	18·80	8·000	0·360	1·01	1·330	13·2	3·3
Lambeth	Turbid	0·000	0·008	0·150	0·074	19·90	8·170	0·460	1·01	1·600	13·2	3·7
Other Companies.												
Kent	Clear	0·000	0·002	0·450	0·003	28·70	11·310	0·680	1·59	4·130	19·4	7·0
New River	Clear	0·000	0·006	0·150	0·033	18·20	8·060	0·430	0·97	1·330	12·6	3·3
East London	Clear	0·000	0·007	0·090	0·047	17·80	7·320	0·460	1·01	1·330	12·0	3·3

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

MISCELLANEOUS.

University of London.—The following is a list of candidates who have passed the recent DSc. Examination:—Branch IV. Inorganic Chemistry—John May Herbert Munro, Royal College of Science, Dublin. Branch VI. Electricity (Treated Experimentally)—Oliver Joseph Lodge, University College. Branch VIII. Physical Optics; Heat; Acoustics (Treated Mathematically)—John Frederic Main, Trinity College, Cambridge. Branch X. Comparative Anatomy:—Arthur Milnes Marshall, B.A., St. John's Cambridge, and St. Bartholomew's Hospital. Branch xiv. Geology:—Walter Saise, Royal School of Mines.

Royal School of Mines.—*Associates in Mining and Metallurgy*:—C. W. Folkard, A. K. Huntington, C. W. Voelcker. *Associates in Mining*—C. H. Liveing, W. H. Merritt. *Associates in Metallurgy*—A. C. Copeland, J. F. Hogan, C. H. Lemann, W. Leyson, E. T. McCarthy. *Associate in Geology*—A. R. Sawyer, A.R. The Edward Forbes medal and prize of books was awarded to A. Heilprin. The De la Beche medal and arize of books to E. W. Voelcker. The Murchison medal and prize of books to F. G. Mills.

NOTES AND QUERIES.

Free Oxygen in Water.—I shall feel obliged if any reader of the Chemical News will favour me by giving an easy and trustworthy method of estimating the free oxygen dissolved in water.—F.R.S.

Bisulphide of Carbon.—How many manufacturers are there in this country? What is the wholesale price per ton, and who are the chief users? Is there a market for the pure article, and what is its price per ton?—Methylamine.

Egg Albumen and Blood Albumen.—Where can I obtain particulars as to manufacture of above? I have consulted Encyclopædias, but can find no details. How is the raw material to be obtained in quantity? What is the process and machinery, and what are the applications of the manufactured article? Can any reader assist me in these queries?—X. Y. Z.

TO CORRESPONDENTS.

E. S. G.—Your questions are not suitable for our "Notes and Queries" column. The first is not intelligible, and there is not a book written on the second.

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THE CHEMICAL NEWS.

VOL. XXXVI. No. 921.

ON REPULSION RESULTING FROM RADIATION.—PART IV.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 15.)

186. In a former paper on this subject, communicated to the Royal Society, March 20, 1875, I gave some rough observations (110, 111) on the effect of the different rays of the electric and solar spectrum on the horizontal torsion-balance (102); and in a note (111) I said, "Every thing is ready to try a series of experiments with the solar spectrum, as soon as sunshine is available. The results shall be communicated in a subsequent paper."

The apparatus which I have now used for this purpose is shown in figs. 12 and 13. Fig. 12 shows the horizontal torsion-balance; it is similar in appearance to the one described in par. 102. *a b* is a piece of thin glass tubing, sealed off at the end *b*, and ground perfectly flat at the end *a*. In the centre a circular hole (*c*) is blown, and another one (*c'*) at the end, the centre hole being at the back, and the one at the end in front. The edges of these holes are ground quite flat. *a*, *c*, and *c'* can therefore be sealed up by cementing flat transparent pieces of plate glass, quartz, rock-salt, &c. (*a*, *d*, and *d'*) on them.

FIG. 12.

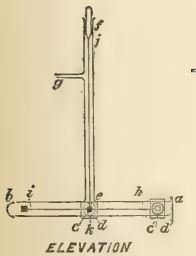
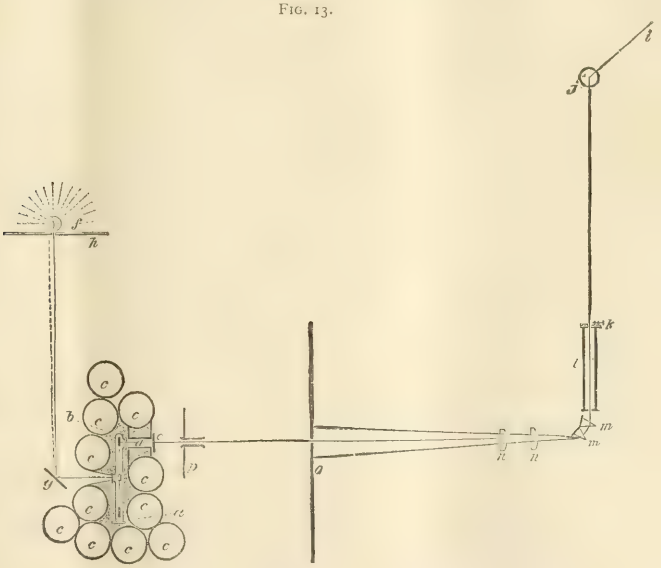


FIG. 13.



To the centre of *a b* an upright tube (*e f*) is sealed, having an arm (*g*) blown on it for the purpose of attaching the apparatus to the pump. *h i* is a glass index drawn from glass tubing, and as light as possible consistently with the needful strength. A long piece of this tube is first drawn out before the blowpipe, and it is then calibrated with mercury until a piece is found having the same bore throughout; the necessary length is then cut from this portion. *j k* is a very fine glass fibre, cemented at *j* to a piece of glass rod, and terminating at *k* with a stirrup, cut from aluminium foil, in which the glass index (*h i*) rests. In front of the stirrup is a thin concave glass mirror, shown at *k*, silvered. The suspending thread is selected of the proper stiffness by the method given in par. 103. The small glass rod hung on to the end of the fibre to test its torsion weighs 15·46 grains; its length is 90 millims., and its external diameter 3 millims. The selected fibre, having this glass rod suspended to it in air, was found to vibrate half oscillations in 35 seconds.

The weight of the beam with the blackened pith ends is 0·891 grain; the mirror and stirrup by themselves weigh 0·87 grain; therefore the whole beam, as suspended, weighs 1·761 grain. The length of the beam from centre to centre of the pith squares is 147·5 millims. This beam is so light, and the pith surfaces are so large, that its vibration in air, when suspended from the glass fibre, cannot be timed. Therefore to ascertain what the torsion of the fibre is with that weight suspended on it, I cemented a piece of platinum weighing 1·543 grain (1-10th gramme) to the fibre, cut to the proper length, and timed its oscillations. 10 half-vibrations were taken by a chronograph. The times recorded during three experiments were—

9·5 seconds, 9·6 seconds, 9·6 seconds;

so that *in vacuo* the beam ought to take about two seconds for each complete oscillation.

* A Paper communicated to the Royal Society, February 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

The pith surfaces at the ends of the beam are 13 millims. square; they are very thin, and are lampblacked on the surface. The window in the centre (*d*) is of plate glass, the window at *d'* is of quartz. They are on opposite sides of the apparatus, as will be better seen by referring to fig. 13.

187. When fitted up for spectrum observations the whole arrangement is shown in Fig. 13. *a b* is the torsion-apparatus, shown in plan, the pith disks being represented by black lines at the ends of the central fine line representing the beam. The suspended mirror is shown in the centre of the beam. The quartz window is shown at the end *b*, and the other window opposite the central mirror. *c*, *c*, *c* are Winchester quart bottles full of water, and each encased in brown paper to prevent it accidentally acting as a lens, and condensing light on any part of the apparatus. Between the bottles, and surrounding the apparatus on all sides, as well as above and below, cotton-wool is well packed, spaces being left only for the rays of the spectrum to pass to the pith disk, and for the index ray of light to pass to and from the mirror. The cotton-wool acts as an excellent non-conductor of heat, and also prevents air-currents. The water in the bottles keeps the apparatus of a nearly uniform temperature, and entirely prevents sudden changes. *d* is a cardboard tube, blackened inside, for the light to pass along; it has a movable shutter (*e*) at the outer end, which can be opened or closed by a touch of the finger without shaking the apparatus. The torsion-balance is firmly fastened to the walls of the room, which are very thick and firm, whilst the bottles and rest of the apparatus are supported by the floor; vibration caused by walking about or touching any of the other pieces of apparatus is therefore not communicated to the torsion-beam. *f* is a small lamp, a ray from which, passing through a narrow slit, falls on the inclined mirror (*g*), whence it is reflected to the suspended mirror of the torsion-apparatus. The light is now reflected back again to the mirror (*g*) and the graduated scale (*h*), where its position indicates the movements of the torsion-beam. The mercury-pump (not shown in the figure) is at some distance from the apparatus, so that the radiation from my body might not affect the apparatus when the pump was set working.

The ray of sunlight (*i*) falls first on the silver mirror (*j*) of a heliostat moving by clockwork; thence it is reflected to the slit *k*, along the tube *l*, through the prisms *m*, and the lenses *n*. *o* is a large screen, with a narrow vertical slit in it, so as to allow only the part of the spectrum I wished to experiment with to pass on to the apparatus. *p* is another screen extending for a considerable distance, and intended to prevent extraneous light from entering the apparatus when the shutter (*e*) is opened. It has a square aperture of such a size that a beam of light passing through it will just cover the pith surface (13 millims. square). The slit was kept half a millimetre wide during the experiments; the focus of the lenses was so adjusted as to form a sharp image of the spectrum lines at the place occupied by the square of pith on the torsion-beam. The slit and prisms are on a firm stand, capable of rotating through a small angle on a centre near the prisms. By this means any desired portion of the spectrum can be thrown on the pith without disturbing the focus. This necessitates an alteration in the adjustment of the heliostat, but that is soon effected. Slight alterations in the position of the spectrum can be made by moving one or both of the lenses sideways.

The distance between the slit and prisms is 16 inches; from the prisms to the pith surface is 7 feet 8 inches. The length of the spectrum here is 200 millims. from the lines A to G. The apparatus was fitted up in a room which admitted the sun in the right direction from about 10 a.m. to half-past 1 p.m. The heliostat was sufficiently good to keep a beam of light on the apparatus the whole of that time.

(To be continued.)

ON THE

DETERMINATION OF THE ORGANIC MATTER IN POTABLE WATERS.*

By W. DITTMAR and H. ROBINSON.

In the analysis of a potable water the most important element to be determined is the quality and quantity of the organic matter, but unfortunately the direct solution of this problem is, and probably for a long time will remain, beyond the range of the resources of chemical science. All that we possess at present are those two indirect methods proposed about the same time ten years ago; the one by Messrs. Wanklyn and Chapman, the other by Drs. Frankland and Armstrong, and which generally go by the names of "Frankland's process" and "Wanklyn's process" respectively. Both these methods are universally known in all their details; but, that being so, it is surprising to see, and utterly inexplicable on scientific grounds, that so many chemists—especially Mr. Wanklyn and Dr. Frankland themselves—look upon the two methods as quite directly competing with each other; so that, assuming one of them to be proved the better, the other has no *raison d'être*. It is true, if organic matter to be determined could be approached only by proximate analysis on the one hand or ultimate analysis on the other, and if Mr. Wanklyn gave out his albuminoid ammonia process as a means for determining the total organic nitrogen, Dr. Frankland would clearly be in the right and Mr. Wanklyn in the wrong. But nobody would suspect Mr. Wanklyn of looking upon his permanganate process as being anything more or less than a particular form of his method of "limited oxidation"—one of the many ways, in fact, in which organic matter may be questioned by the quantitative application of generic disintegrators. Now, after the many critical experiments made by Messrs. Wanklyn and Chapman, nobody can reasonably deny that Wanklyn's "albuminoid ammonia," although in general rather a complex quantity, bears a definite relation to that part of the nitrogen of a water which exists in certain states of combination, and consequently *is* a result worth booking, in addition to the total organic nitrogen; while Mr. Wanklyn himself, on the other hand, would surely be the last to deny that his method, in its present form, is far from being so absolutely constant in its results as not to be all the better for being supplemented by a determination of the organic carbon and total organic nitrogen. Clearly the two methods, far from being antagonistic, are destined to supplement each other. No doubt all analysts would soon come to take this view of the matter and act upon it, if it were not for the fact that Frankland's method, although certainly not difficult, is very slow of execution, and involves the use of cumbrous, costly, and easily-deranged apparatus. What is wanted is so to modify Frankland's process as to considerably shorten it and bring it within the range of ordinary laboratory appliances. This problem seemed to us worth working at, and we accordingly devoted to it part of last summer's holidays; but through various circumstance we were compelled to shelve the subject for a considerable time, and it was only lately that we got the experiments completed.

Determination of the Organic Carbon.

The idea which guided us in the experiments to be recorded under this head was that Frankland's process might be considerably shortened, without any loss of precision, by devoting to this determination a separate quantity (say about a litre) of the water, and—

1. Doing the greater part of the concentration by boiling down with sulphurous acid in a slanting flask; and

* Read before the Chemical Section of the Glasgow Philosophical Society, April 30th, 1877.

2. Determining, by combustion, the carbon in the residue by a proper modification of the ordinary gravimetric, instead of Frankland's troublesome gas-volumetric, process.

About the first point we had at first some serious misgivings, which, however, we are now able to say, after considerable experience, proved unfounded. The practicality of the second point, on the other hand, seemed to us almost self-evident, but it was precisely the one which gave us the greatest amount of trouble to settle.

The *modus operandi* we adopted for the combustion differed in very little from the customary one:—The residue—obtained by boiling down, in a slanting glass flask, a mixture of the water and sulphurous acid, and evaporating to dryness in a glass vessel on a water-bath—was mixed with a convenient quantity of chromate of lead, the mixture introduced into a combustion-tube about 8 to 9 m.m. wide inside and 30 c.m. long,—previously drawn out at one end into a bayonet-shape,—a reduced copper-gauze spiral placed in front of the mixture, and the combustion conducted in a current of air supplied by a glass gas-holder charged with dilute caustic soda. For the absorption of the water we used a little V-shaped tube containing 60 per cent sulphuric acid, with which was united permanently a short tube filled with granulated chloride of calcium. From this apparatus the product passed through a small, and consequently light, soda-lime tube (having, of course, a layer of chloride of calcium, at its exit end), for the absorption of the carbonic acid. The balance we used was a fine Oertling, which, when moderately charged, was constant in its indications to within less than 1-10th m.grm. The tare of the tube proved perfectly constant; hence the CO_2 weights observed could be assumed to be correct to within 1-10th, or at most 1-5th, of a m.grm.—equal respectively to 1-40th or 1-20th of a m.grm. of carbon. And this degree of precision is quite sufficient, so that it is needless to enquire whether Frankland's volumetric *modus* would go further—which we beg leave to question.

When we came to test this method by rehearsals with small known weights of pure substances we were surprised to find that our results were all too high. Thus, for instance,—

7·69 m.grms. sulphate of quinine* gave 18·4 m.grms. CO_2, instead of 15·5.

10·64 m.grms. hippuric acid gave 24·56 m.grms. CO_2, instead of 23·54.

8·37 m.grms. hippuric acid gave 21·35 m.grms. CO_2, instead of 18·51.

Where did this excess of carbonic acid come from? The chromate of lead which had been used seemed safe and sound. We had not prepared it ourselves, but its appearance showed it had gone through a thorough process of fusion; besides, before being considered fit for use, it had been powdered, kept at a dull red-heat in platinum for a considerable time, and then preserved in a glass-stoppered bottle covered with a glass shade to keep off dust. To get at the source of the error we carried out a systematic series of blank experiments, which soon brought the result that the piece of india-rubber tubing which had been used to join the gas-holder to the combustion-tube gave up enough of carburetted hydrogen vapour to the air to furnish, when burned and sent through baryta-water, an appreciable precipitate. So, thereafter, we made it a strict rule never to use more india-rubber for any joint than was absolutely necessary for producing a sufficient degree of flexibility. When the air was now passed through the empty tube, at a red-heat, the baryta remained clear; but when the experiment was repeated with chromate of lead in the tube there was a *dense* precipitate of carbonate formed. We accordingly re-fused our chromate in a platinum crucible, and kept it at a bright red-heat until part of the oxygen had boiled off, poured the liquid mass into a platinum dish, pounded it in a porcelain mortar, and immediately bottled it up. But even with such chromate the baryta-water became as muddy as ever. We then prepared chromate of lead ourselves by decomposing *bi*chromate of potash with nitrate of lead, washing the precipitate by decantation only, drying it in a porcelain basin, and heating it in a small porcelain dish within a Griffin's muffle to the highest temperature which could be used without fusing it. But this preparation also, when heated in air, gave off large quantities of carbonic acid. We next fused this chromate, but it did no good. We were thus forced to the conclusion that chromate of lead, even when free from excess of oxide (PbO), eagerly absorbs carbonic acid from the air or the flame-gases, which cannot be expelled by mere heating in a crucible. There is, however, a way of getting a safe chromate: it consists in taking the ordinary preparation, and heating it in a combustion-tube to redness in a current of pure air until it ceases to give off anything that renders baryta-water turbid, and to use the product *immediately* for the combustion to be made. In this manner the following analyses were made:—

	Substance.	CO_2 found.	CO_2 calculated.
1.	5·700 m.grms. mannite	8·26	8·26
2.	6·200 ,, ,,	9·10	8·94
3.	3·316 ,, urea	2·43	2·43
4.	3·316 ,, ,,	2·80	2·43
5.	3·316 ,, ,,	2·20	2·43

The urea in experiments 3, 4, and 5 was weighed indirectly by measuring off the proper volume of a standard solution. In No. 3 the solution was evaporated to dryness, with addition of a pinch of sulphate of potash in order to obtain a sufficient body of residue: in the case of Nos. 4 and 5 the urea was dissolved in 500 c.c. of pure water, the solution mixed with 75 m.grms. of common salt, 16 m.grms. of anhydrous carbonate of soda, 5 m.grms. of acid sulphite of soda, and 30 c.c. of a strong aqueous solution of sulphurous acid; the whole boiled down to a small bulk in a slanting flask, and the residue evaporated to dryness in a basin covered with a screen of filter-paper on a water-bath. The results, although not quite so exact as we could have wished, are sufficiently near the truth for practical purposes: at any rate it was not the method of combustion used which caused their relatively high values (+0·37 and −0·23 m.grm. in CO_2, or +0·1 and −0·06 in C).

We next tried oxide of copper instead of chromate of lead. The result was that the oxide, although it contained carbonic acid after having been kept for a long time, even in a glass-stoppered bottle, readily gave up its carbonic acid on ignition in a muffle, and then, when carefully preserved, remained all safe for a week or fortnight at least.

Unfortunately Dr. Frankland's lecture on Water Analysis (*Chem. Soc. Journal* for 1876, p. 825), in which he recommends oxide of copper instead of chromate of lead, without saying why he made the change,—for he prescribed the use of chromate in his original memoir, and again in his paper in vol. vi. of the "Rivers Pollution Commission,"—came to hand only after we had finished our work, or it would have saved us a considerable amount of trouble.

On looking back upon our experiments now, it strikes us that the loss of time and the trouble involved in our method of carbon determination could probably be reduced to a minimum by something like the following *modus operandi*:—Take a combustion-tube wide enough to accommodate a conveniently-sized platinum boat; charge it with (1) a spiral of silver†-wire gauze, (2) a layer of granulated oxide of copper, and, after having attached our water-absorption apparatus (of which the V-shaped part

* 0·5 grm. of which gave 0·1349 of sulphate of baryta = 9·26 per cent of SO_3 instead of 9·19.

† A German chemist, whose name we forget, found some years ago that red-hot silver reduces nitrogen oxides as effectively as copper does; of course, without itself suffering permanent change.

should be charged with a solution of chromic acid in 60 per cent sulphuric, to absorb the sulphurous acid that must be expected to come over), heat the silver and oxide of copper to redness in a current of carbonic acid-free air, until the air as it comes out no longer precipitates baryta-water. Now introduce the boat charged with the water residue, attach the tared soda-lime tube, and execute the combustion as usual. At the end of the analysis the tube would be ready for another combustion.

Determination of the Organic Nitrogen.

In the execution of this determination one of the difficulties to be overcome is the thorough elimination of the nitrogen of the nitrates and nitrites. In regard to this problem we are glad to be able to confirm the experiences of Drs. Frankland and Armstrong, and to say that we found their method to work satisfactorily (evaporation with sulphurous acid and a little iron-salt). This point being settled, it seemed to us that the determination of the organic nitrogen of a water might easily be effected in the following manner:—Starting with, say, half a litre of water, boil it down in a pear-shaped flask connected with a Liebig's condenser (taking care to avoid overheating the empty part of the flask), and "Nesslerise" the ammonia as it comes over. With a little experience it is quite easy in this manner to concentrate the water to about 25 c.c. without overheating any of the dissolved matter. We may also give it here at once as the result of our present experience that the ammonia is all contained in the first 100 to 150 c.c. of distillate. After having thus got rid of 19-20ths of the water, add the requisite quantity of sulphurous acid and ferric chloride, and, if necessary, something to give body to the residue —we usually employed sulphate of potash; complete the evaporation with the necessary precautions on a water-bath, burn the residue with soda-lime, collecting the ammonia in highly dilute hydrochloric acid, and determine it colorimetrically according to Wanklyn and Chapman.

When we proceeded to rehearse this method our difficulties with chromate of lead were still fresh in our memory, and we were therefore not over-much surprised that even when we worked upon pure ammonia-free water, or solutions in such water of small quantities of nitrate of potash, the distillates obtained on combustion contained very appreciable quantities of ammonia. We shall not trouble the reader with an account of the many experiments we made to ascertain the source of this ammonia: suffice it to state that we succeeded in almost absolutely eliminating the error by an improved construction of our water-bath, and by a peculiar modification of Varrentrapp and Will's method of nitrogen determination. Our water-bath may be shortly described by saying that it is a slight modification of Dr. Bischof's well-known apparatus, from which in fact it essentially differs only in this—that the steam is sent back into the boiler by an inverted condenser, and that the basin is connected with the bath by means of a mercury valve, so that, although the steam strikes directly against the basin, none of it can get into contact with the contents of the basin, which is nevertheless directly heated by the steam, and consequently maintained at the highest possible temperature. The mercury valve worked most satisfactorily; but we do not describe it because we used it merely as a makeshift to be replaced by a solid metal joint, *i.e.*, a conically-ground ring of brass cemented to the basin, and fitting into a corresponding conical socket on the bath. Our evaporating apparatus stood in a separate room, not communicating with any other room, and by observing certain obvious precautions we easily avoided the breathing of mercury vapours, which, in fact, as long as the bell-jar is in its place, cannot get into the laboratory; but, after all, mercury vapours are not to be trusted, and had better not be produced unnecessarily.

Our method of combustion consists in this—that we place the water-residue in a large copper or silver boat, moisten it with a drop of water, place on it about 3 grms. of a fused mixture of equal weights of pure baryta ($Ba(HO)_2$)* and sodium-soda, and, after having introduced the boat into a short combustion-tube by the exit end with an absorption apparatus charged with highly dilute hydrochloric acid water, very gradually heat the boat—ultimately to dull redness—in a current of hydrogen, when the nitrogen is all eliminated as ammonia, which is easily measured with a sufficient degree of exactitude by means of Wanklyn's colorimetric method.

Before actually using the combustion-apparatus it is indispensable to heat the empty tube with the absorption-apparatus attached in a current of hydrogen until every trace of ammonia which stuck to the surface of the tube, the cork, &c., is expelled, and then to let it cool down in a slow current of hydrogen. It is also necessary to determine once for ever the amount of ammonia which the working quantity of soda-baryta used in each analysis gives up when burned with, say, a few milligrammes of sugar or mannite. This ammonia—which, with pure preparations, will not amount to more than 1 to 2 hundredths of a milligramme—must be deducted from the ammonia found in our analyses as a constant error.

In proceeding now to give what evidence we have to offer of the exactitude of our method, we should begin by reporting a number of blank experiments made with pure water, which, with us, means distilled Loch Katrine water freed from its ammonia by fractional re-distillation with a pinch of carbonate of soda. But we think it will suffice to say that, although in all cases the "organic ammonia found, instead of being =0, amounted to something measurable by Nessler's reagent, we found it easy, by careful work, to bring down this quantity to one or two hundredths of a milligramme.† But let us now pass to our analyses:—

1. 12·9 m.grms. of hippuric acid, weighed out dry and burned with soda-baryta, gave a quantity of NH_3, of which one-tenth, when Nesslerised, was found in two experiments to amount to 0·12 m.grm. of ammonia. The formula demands 0·12.
2. 50 m.grms. of nitrate of potash, dissolved in 200 c.c. of pure water, alkalinised with caustic soda until the distillate showed nothing with Nessler,—residue evaporated with 45 c.c. of aqueous sulphurous acid and a few drops of ferric chloride,—obtained, on combustion, 0·03 m.grm. ammonia (NH_3) instead of 0·00.
3. A similar experiment, with nitrate of potash =10 m.grms. of ammonia, and hippuric acid =0·10 m.grm. ammonia, gave 0·18 m.grm. of ammonia—*i.e.*, 0·08 m.grm. too much. (A failure.)
4. Nitrate of potash =5 m.grms. of ammonia, hippuric acid =0·10. Found 0·15 m.grm. of ammonia. Excess found =0·05 m.grm., which is rather more than can be tolerated.
5, 6, and 7. Experiments with artificial waters. *Modus operandi:* 650 c.c. of pure water distilled down to 500—the residue now absolutely free from ammonia —charged with known quantities of nitrogenous materials, and free and organic ammonia determined.

In Exp. 5 there were added known quantities of sal-ammoniac, sulphate of quinine, and nitrate of potash. Results:—

	Free NH_3.	Organic NH_3.	Nitric NH_3.
By synthesis ..	0·10	0·100	0·017
By analysis ..	0·10	0·095	—

* Why the baryta? Well, soda alone would probably do. We originally intended to effect the fusion in the tube itself, and added the baryta to moderate the action of the baryta on the glass. And as we had a stock of the mixed reagent on hand we used it. It fuses at a remarkably low temperature, and, in an atmosphere of hydrogen does not act much even on copper.

† In the analyses given below this purely adventitious ammonia is not allowed for: we prefer giving the numbers as we found them.

In Exp. 6 the substances used were sal-ammoniac, nitre, and urea. Results :—

	Free NH_3.	Organic NH_3.	Nitric NH_3.
By synthesis ..	0·05	0·140	0·17
By analysis ..	0·05	0·162	—

In Exp. 7 the substance used consisted of urine solids diffused throughout a large body of sulphate of potash. 1·0115 grms. of this mixture, when burned with soda-lime in the ordinary fashion, gave 0·0488 grm. platinum, = 8·41 m.grms. ammonia—*i.e.*, 8·31 m.grms. ammonia per gramme. 28·1 m.grms. of these dilute urine solids were dissolved in half a litre of absolutely pure water, prepared as in Nos. 5 and 6, and the water analysed. "Free ammonia" in the several fractions of distillate (each = 50 c.c.) was found to be—

1st.	2nd.	3rd.	4th to 9th.	Total.
0·013	0·004	0·001	Nil.	0·018

"Organic ammonia," as found by combustion, amounted to 0·225 : hence "total ammonia" = 0·243 m.grm. The above analysis demands 0·233 m.grm.

It is surprising to see the very slight extent to which the urea was decomposed in the course of such a protracted distillation with an immense quantity of water, and notwithstanding the presence of those other urine constituents which usually are supposed to deprive urea of its stability against water. No doubt part of the 0·018 of our "free" ammonia really did come out of ammonia salts : hence about 95 per cent of the urea survived the distillation.

It seemed to us interesting to see what would come of the application of Mr. Wanklyn's method to such an artificial water. We accordingly dissolved 29·5 m.grms. of dilute urine solids in 500 c.c. of absolutely ammonia-free water, and next distilled off 300 c.c. for the determination of the "free ammonia." In the remaining 200 c.c. the "albuminoid" was determined by means of alkaline permanganate, as prescribed by Mr. Wanklyn in his book. The results were—

Free ammonia, 0·021.

Albuminoid ammonia (in the several fractions of distillate)—

50 c.c. of Distillate.				
1st.	2nd.	3rd.	4th.	
0·042	0·0075	0·015	0·02	
In all				0·085
A blank experiment with the reagent and pure water gave				0·007
Albuminoid corrected				0·078

Reducing to 28·1 m.grms. of dilute solids and combining with No. 7 we have—

Free NH_3.	Albuminoid.
0·018	0·074

The total organic NH_3 (according to No. 7) is 0·225 —*i.e.*, above three times the albuminoid.

To be able to supply exact data as to the amount of time required for executing a nitrogen determination according to our method, we timed one of the analyses of artificial waters. We commenced work at 10.30 a.m. The "free" ammonia was determined and the residue ready for combustion by 1.30 p.m., and the combustion finished and the ammonia Nesslerised by 2.10 : that is to say, the whole of the analysis was done in less than four hours, which compares very favourably with Dr. Frankland's process. With regard to the degree of exactitude attainable, the latter process no doubt is superior to ours in those cases in which the quantity of nitrogen present is large, as, for instance, in the analysis of sewage or positively foul waters ; but these are precisely the cases where a relatively high degree of precision is uncalled for. Passing to the more important case of a water which is not positively bad, we feel sure it will be admitted that our process, even in point of precision, is far ahead of Frankland's ; besides, it enables one to *measure* quantities of ammonia which, if given as nitrogen gas, would be barely visible in a eudiometer.

After what we said in the introduction we need not specially state that we do not mean our process of nitrogen determination to supersede Mr. Wanklyn's albuminoid ammonia process. We should be sorry to see that process fall into abeyance, because, whatever may ultimately turn out to be its real value, no doubt it is a step in the right direction,—in that direction, in fact, in which the science of the subject will progress, if it is to advance at all.

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ON AMMONIUM VANADIATE PRECIPITATED FROM ALKALINE VANADIATES WITH AMMONIUM CHLORIDE.

By Dr. B. W. GERLAND.

THE precipitation of the alkaline vanadiates by ammonium chloride has been already applied by Sefström and Berzelius, and was recommended by von Hauer for the quantitative separation of vanadium from the alkalies, and since then adopted in all text-books. I also made use of this method for a quantity of potassium sodium vanadiate containing several kilogrms. vanadic pentoxide, and obtained the ammonium salt, which, carefully washed, yielded a pentoxide that crystallised beautifully when solidifying from its molten state, but contained, nevertheless, a considerable amount of alkalies. As I could find no reference to this experience, I undertook the investigation, and obtained the following interesting results :—

(1.) Vanadic pentoxide was fluxed with 3 molecules potassic sodic carbonate, the solution of the flux poured into a boiling solution of ammonium chloride, filtered after cooling, and washed with ammonium chloride solution until the washings volatilised without leaving a residuum, then washed with weak alcohol until the reaction for chlorine had disappeared. The salt was then pressed and dried in the exsiccator. 1 grm. of this ammonium vanadiate was submitted to analysis in the following manner :—The aqueous solution was precipitated with lead acetate, the filtrate treated with sulphuretted hydrogen, after separation of the precipitate evaporated to dryness, and heated for the volatilisation of the ammonium salt. The small residuum contained a little vanadium, and was therefore again treated in the same way. After the ammonium salts had been driven off the second time, the residuum was moistened with hydrochloric acid, heated to dull redness, and weighed. It consisted of potassium chloride with a trace of vanadic pentoxide. Weight, 0·0418 grm., or 4·8 per cent ; containing chlorine (found), 1·92 per cent ; calculated potassium, 2·11 per cent.

(2.) The ammonium vanadiate of No. 1 was dissolved in water (accidentally in well water) under addition of ammonia, the solution poured into a concentrated boiling solution of ammonium chloride, and the precipitate treated as above. Found—

Lime	0·28 per cent.
Potassium chloride ..	0·23 per cent.

(3.) Vanadium pentoxide was fluxed with 3 molecules sodium carbonate, and the ammonium salt prepared and purified as described under No. 1. It was, according to the analysis, free from sodium. The analyses of this and the following salts were carried out as in No. 1, with this modification : the filtrate from the lead vanadiate was heated, ammonia and ammonium sulphide added, the boiling continued until the liquid was completely decolour-

ised, and then filtered without delay and interruption. Much time is saved by this method, and the advantage gained that the small amount of vanadium is almost entirely separated with the lead sulphide; only unweighable traces are left in solution.

(4.) Ammonium vanadiate prepared with the detailed precautions from potassium ortho-vanadiate.

1·4034 grms. yielded 0·0757 grm. potassium sulphate; this sulphate yielded 0·1027 grm. barium sulphate; calculated from the K_2SO_4 0·1013 grm. barium sulphate.

The ammonium vanadiate therefore contained 2·42 per cent potassium.

(5.) The ammonium vanadiate of No. 4, re-crystallised from water. 0·5334 grm. yielded 0·0046 grm. potassium sulphate

The ammonium vanadiate therefore contains 0·39 per cent potassium.

The ammonium vanadiate of No. 4 dissolved in water, the solution poured into a concentrated boiling solution of ammonium chloride. 1·0705 grm. yielded 0·0069 grm. potassium sulphate.

The purified ammonium vanadiate therefore contains 0·25 per cent potassium.

In all these experiments the ammonium vanadiate was precipitated under the most favourable conditions. If, according to the directions generally given, the separation is effected by placing solid sal-ammoniac into the solution of the alkaline vanadiate the amount of potassium increases considerably.

Ammonium vanadiate, therefore, cannot be obtained free from potassium by precipitation with ammonium chloride if the solution contains potassium, whilst the presence of sodium salts does not interfere with the purity of the vanadiate.

The obstinacy with which potassium is retained by vanadium compounds is remarkable. It is not limited to the ammonium vanadiate separated from alkaline solutions, but also manifests itself with different compounds of other oxides of vanadium, whether they are formed in acid or alkaline liquors. Thus, according to my observations, the compounds $V_2{}_3SO_4$ and $V_2{}_1H_2{}_4SOH$ (vanadic sulphates, which I shall shortly describe), $V_2O_2{}_1H_2{}_3SO_4$ and $V_2O_2{}_1{}_2SO_4$ (vanadylous sulphates), all formed in strongly acid solutions, enclose potassium, if present, and in the case of the insoluble vanadic sulphates it cannot be extracted by boiling with dilute hydrochloric or sulphuric acid.

Ammonium behaves to some extent similarly to potassium. As I have already mentioned (Chemical News, vol. xxxiv., p. 2), the bronze-like metavanadic acid retains a small amount of ammonium, which cannot be removed by treatment with acids. Several metallic salts of vanadic acid—for instance, copper ortho-vanadiate—contain ammonium present in the liquor in which it is formed, and the latter cannot be removed by washing.

Macclesfield, July, 1877.

REACTIONS BETWEEN SOLUBLE AND INSOLUBLE SALTS.

By WATSON SMITH, F.C.S.

I. Wurtz says of such reactions that they are characterised by a change of elements, which tend to establish themselves. Thus, if a sodium carbonate solution be boiled with one of barium sulphate a partial decomposition takes place, barium sulphate is partially converted into barium carbonate, insoluble like the sulphate, and in solution there is a certain quantity of sodium sulphate. This decomposition is the more complete the larger the proportion of sodium carbonate employed. Thus the influence of masses is considerable. Now when sodium sulphate is made to react upon barium carbonate by boiling a solution of the former with a quantity of the latter a partial double interchange also takes place. Even in the cold this interchange occurs to some extent, barium sulphate and sodium carbonate being formed.

II. I have recently found that between the alkaline oxalates and the earthy carbonates (and other insoluble metallic carbonates) a partial double decomposition occurs, insoluble earthy oxalate and soluble alkaline carbonate being formed.

As already known, on the other hand, alkaline carbonates on boiling decompose the earthy oxalates. I attempted a measurement of the extent of decomposing force put forth in the above cases, both in the cold and in boiling solutions, by taking equivalent weights of the salts, the same volume of water, allowing to stand during the same time, or when boiling boiling for the same time, and washing with the same volume of water. The results were reckoned in terms of sodium carbonate as follows:—

Action of sodium oxalate on the earthy carbonates, viz., of—

	Cold.	Hot.
Calcium	19·83	22·90
Strontium	7·63	7·38
Barium	4·84	4·98
Lead	6·35	13·08

Per cents of Na_2CO_3 formed of what would be if decomposition complete

Action of sodium carbonate on the oxalates of—

	Cold.	Hot.
Calcium	16·07	52·34
Strontium	57·24	79·96
Barium	73·20	87·96
Lead	81·54	90·61

Per cents of Na_2CO_3 converted into oxalate of what would be if decomposition complete.

III. Recently a paper has appeared in the *Bull. de la Soc. Chim, de Paris*, xxvii., No. 11, p. 499, by Messrs. A. Frebault and A. Destrem, in which they testify to having found that neutral phosphate of sodium decomposes the insoluble carbonates under already mentioned circumstances. Thus sodium phosphate decomposes calcium carbonate, and the CO_2 resulting unites with the soda set free to form sodium hydrogen carbonate, which decomposes on boiling into Na_2CO_3 and CO_2. The decompositions they express in two equations:—

1. *Hot.* $2[PO_4Na_2H] + 3(CaCO_3) =$
$= Ca_3(PO_4)_2 + 2Na_2CO_3 + H_2O + CO_2.$

2. *Cold.* $2[PO_4Na_2H] + 3(CaCO_3) =$
$= Ca_3(PO_4)_2 + 2.NaHCO_3] + Na_2CO_3.$

It was further found that all the insoluble carbonates are decomposed by sodium phosphate, the rule being verified in the case of the following carbonates:—$BaCO_3$, $MgCO_3$, $ZnCO_3$, $MnCO_3$. The fact appears to the authors of great importance in relation to the formation of the natural phosphates, and in the grouping of the elements in the analysis of mineral phosphatic waters. However, the authors have committed one rather serious blunder; they make the following assertion:—"Calcium phosphate cannot decompose sodium carbonate to form sodium phosphate and calcium carbonate, whilst sodium phosphate decomposes calcium carbonate, forming calcium phosphate and sodium carbonate." Now whether anything still earlier in contradiction of the above has been discovered I do not happen to know; but this I know, that in the early part of last year, or about the close of 1875, my friend, Mr. C. T. Cross, made some experiments in the laboratory of Zürich University on the action of boiling solutions of sodium carbonate on the precipitated phosphates of the alkaline earths, and found that decomposition did take place. On repeating the experiments I found that in the case of calcium phosphate (precipitated) not only does a boiling solution of sodium carbonate decompose it, but

that a cold concentrated solution, on standing for half a day, with frequent shaking, also decomposes it to some extent.

IV. The thought now occurred to me, "Sodium carbonate solution decomposing both calcium oxalate and calcium phosphate, is it possible that sodium oxalate will act upon calcium phosphate so as to bring about a mutual interchange of basic elements."

a. I boiled for two hours about equivalent weights of sodium oxalate and pure precipitated calcium phosphate together. The amount of water present was sufficient to form a tolerably concentrated solution of the sodium oxalate. On filtering and evaporating I was able to crystallise out sodium phosphate; the quantity formed was proportionately larger. The mutual decomposition, therefore, appears in this case to approach completeness.

b. Some pure calcium oxalate was now boiled with ordinary sodium phosphate for two hours, the phosphate being in excess. The whole was now filtered, and the precipitate washed well with hot water. The filtrate was evaporated to dryness, and ignited well. The ignited residue was treated with hydrochloric acid, when a lively effervescence occurred, CO_2 escaping, proving the presence of dissolved sodium oxalate in the filtrate. The precipitate left on the filter was also dried and ignited thoroughly, and then treated with acetic acid, which dissolved a portion of the precipitate with effervescence. A rather small residue was left, and this was tested according to the usual methods for phosphoric acid, which was found abundantly present in the residue, proving it to consist doubtless of calcium phosphate.

The measurement of these reactions, or of the elective affinities under varying circumstances of mass, temperature, dilution, &c., would probably furnish interesting results, and this subject I have now in hand.

Technical Laboratory, Polytechnikum, Zürich.

NOTICES OF BOOKS.

The Laboratory Guide; a Manual of Practical Chemistry for Colleges and Schools, specially arranged for Agricultural Students. By A. H. Church, Professor of Chemistry in the Agricultural College, Cirencester. London: Van Voorst.

This work has now reached its fourth edition, and has been enlarged, and in many respects improved. In judging of its merits it is essential to bear in mind the author's object. He writes for students who are seeking to obtain a practical knowledge of chemistry as applied to agriculture, who can devote but a very limited amount of time to the subject, and who are still expected, at the end of their college career, to make a fairly accurate analysis of a soil or a superphosphate. Hence the omission of the rarer elements, and indeed of all which are not known to have a bearing upon plant-life, or to be useful as reagents, is here perfectly legitimate.

Like the former editions the present work consists of three parts: the first intended as a guide to chemical manipulation, and to give the student a practical acquaintance with the chief classes of facts with which he will have to deal; the second is devoted to qualitative analysis, with the preparation and use of the various reagents required; whilst the third treats of the quantitative analysis of soils, manures, and the produce of the farm. In all these sections, especially in the last, considerable additions have been made. Thus we find instructions for the analysis of beer, butter, cheese, cream, (woody) fibre, hay, leaves, milk, ash of plants, wines, &c. Milk, liable as it is to adulteration, can scarcely from this point of view come under the notice of the purely agricultural analyst, since the fraudulent additions, as a rule, take place after it reaches the dealers in our towns. Mr. Church very rightly repudiates the lactometer and the creamometer, though he places some confidence in the indications obtained by means of the lactoscope. In his directions for taking the total solid matter in milk he does not fall into the error of recommending the addition of plaster or sand during the process of evaporation. A hint on the importance of thoroughly agitating a sample of milk so as to ensure perfect commixture before weighing or measuring off portions for analysis would have been useful. Whilst on this subject we cannot help pointing out that the influence of the race or breed of cows upon the quality of milk has scarcely been sufficiently examined. Mr. Wanklyn, indeed, shows that the prejudice in favour of the milk of the Alderney breed is not well founded; but we have met with no facts as to the supposed poverty of the milk of short-horns as compared with that of the old long-horned breed.

In the processes laid down for the analysis of manures we find little change as compared with the second edition. The methods are practicable, the descriptions are clear, and under any ordinary circumstances a student who follows the instructions here laid down will arrive at accurate results. Were every precaution that may be needed under unusual circumstances given in detail the book would acquire encyclopædic dimensions. For instance, in "bone-dust, bone-shavings, boiled bones, and bone-ash" the amount of tribasic phosphate of lime may doubtless be determined with sufficient accuracy by the method given by Mr. Church—*i.e.*, by precipitation with ammonia, observing certain precautions here stated; but suppose the sample adulterated, as we have once observed, with granulated furnace-slags, containing, of course, alumina and iron oxide soluble in hydrochloric acid, the process is no longer applicable. But an author can scarcely be expected to provide for such exceptional cases.

The arrangement of the combustion-tube in the determination of nitrogen is here illustrated by a figure, and the description is more complete than in the second edition.

The presence of vegetable ivory among turners', scale-cutters', and cutlers' refuse is mentioned as a new impurity, not always, however, to be regarded as an intentional fraud.

The instructions given for the analysis of apatites and coprolites are substantially the same as in earlier editions. When the latter, however, contain much carbonaceous matter the "fusion-method"—ignition of the dry, powdered sample with four times its weight of a fusion-mixture of 2 parts sodium carbonate to 1 part of potassium chlorate or nitrate—is recommended.

The chapter on superphosphates is also essentially unaltered. The "reduced phosphates" are directed to be determined by the bicarbonate of soda method. At the same time the author admits that the results are not as accurate as might be desired, and places on record his opinion that such "reduced" phosphates are by no means of equal value with such as are soluble. With this view we decidedly agree, and we know that several manure-makers of ample experience consider that if such "reduced" phosphates are classed with and valued as "insoluble" phosphate, substantial justice will be done to buyer and seller.

In the determination of phosphoric acid in soils, &c., by the molybdic acid method,—the only really safe procedure,—the molybdic precipitate is recommended to be dissolved in a minimum of *hot* dilute ammonia, which we think an improvement. For the molybdic acid solution, however, we prefer Sonnenschein's formula to the one given by the author. We are also of opinion that a better "magnesia mixture" may be made by adding chloride of ammonium to chloride of magnesium than in the usual manner with sulphate of magnesia.

In the determination of alkaline salts—*e.g.*, in artificial manures—the magnesia present is directed to be precipi-

tated with baryta-water, the excess of baryta being afterwards removed by the addition of the carbonate of ammonia instead of as recommended in the earlier editions, at once precipitating with carbonate of ammonia.

As to the real value of the book, taken as a whole and fairly viewed with reference to the author's object, we do not imagine that there is much room for difference of opinion. We know that it is highly prized by chemists engaged in manure-works, and we are glad to learn that it is adopted by the Indian Government as a manual for agricultural students. It is also the recognised text-book in the Imperial Agricultural College of Japan.

Chemical Handicraft: a Classified and Descriptive Catalogue of Chemical Apparatus. By J. J. Griffin, F.C.S. London: J. J. Griffin and Sons.

This book, as the Preface very truly declares, is something more than a mere price-current. It partakes in no small degree of the character of a treatise on chemical manipulation. The student, the professional analyst, and the philosopher engaged in original research will each be able to see here the instruments which they may require for any especial purpose. Many newly-designed or improved articles have been introduced in this edition, among which we may mention the requisites for the blow-pipe experiments described in Major Ross's "Pyrology," and which are supplied either separately or in complete sets. We are sorry to see that the lactometer and creamometer are still in sufficient demand to warrant their being figured and described in the pages before us.

In gas-burners and gas-furnaces great improvements have been effected. They can now be procured in a great variety of sizes and designs, and are suitable for all processes of ignition, combustion, fusion, or dry distillation, at temperatures ranging from redness to full whiteness. To be thus delivered from the charcoal-, coke-, or coal-furnace, with its cumbrous fuel, its dust, ashes, and fumes, is a boon which experimentalists will duly appreciate. The "gas crucible and muffle furnace" is an exceedingly useful piece of apparatus, and the "miniature blast gas furnaces," No. 1155, will often be found serviceable in analytical operations for ignitions requiring a higher temperature than can be readily procured with a gas-burner.

In graduated glass vessels for volumetric analysis—such as burettes, pipettes, measuring flasks, mixing jars, &c.—improvements have been made, some of which, however, such as the increased accuracy in graduation, cannot be shown by description or illustration. Among burettes, Mohr's, with its modifications, is becoming a more and more recognised instrument, whilst Gay-Lussac's and still more Binks's are falling into desuetude. The latter, indeed, is in many establishments now used only for rough, approximate estimations which have to be performed by workmen. We do not perceive in the catalogue any mention of the apparatus which have been devised for the technological analysis of furnace-gases, chamber-gases, &c.

Physical, as distinct from chemical, apparatus is—with few exceptions—relegated to a distinct catalogue, under the name of "*Scientific Handicraft*," part of which has already appeared, and the remainder is understood to be in progress. Hence microscopes, &c., no longer figure in the work before us.

No one can deny that the compilation of "Chemical Handicraft" represents a very great amount of thought, labour, and patience, and we trust that the useful enterprise of Messrs. Griffin will be appreciated by the profession.

Researches on the Tetrachloride of Carbon, and its Use as an Anæsthetic.—M. C. Morel.—The author having vainly attempted to use the tetrachloride as a cheap source of chloroform, prepared it pure, and used it as an anæsthetic. He considers it perfect, more energetic than chloroform, but more easily regulated.—*Comptes Rendus.*

CORRESPONDENCE.

THE COLLEGE OF PHYSICAL SCIENCE.

To the Editor of the Chemical News.

Sir,—As I believe that all your readers are concerned in the welfare of the Newcastle College of Physical Science I have no hesitation in submitting to you for publication the enclosed from the *Newcastle Daily Journal*.—I am, &c.,

Fred. Guthrie.

"*To the Editor of the Newcastle Daily Journal.*

"Sir,—A copy of your paper has been sent to me containing an account of the distribution of prizes at the Newcastle College of Physical Science, from which it might appear that everything in that institution is as it should be. Some months ago my friend, Prof. Herschel, did me the great honour of asking me to examine some of his pupils. To do so I visited the College. That I found the three candidates whom I examined thoroughly well taught appears from the result of the examination, and is what I expected from pupils of so able and zealous a teacher. I noticed that the 'Preparation' room and 'Physical Laboratory' are totally unfit for their purposes, so much so that on my return home I wrote to the managers, pointing out the deficiencies in language, which I meant to be frank and forcible, without being offensive. As I have not heard from the managers, even to the extent of acknowledging my letter, I conclude that it is not producing the desired effect. The matter is one of such vital importance to your city that I beg you to allow me to lay the letter, as far as I can reproduce it from notes and memory, before your citizens:—

"'To the Managers of the Newcastle College of Physical Science.

"'Gentlemen,—I regret that I shall not be able to avail myself of your polite invitation to be present at the distribution of prizes on the 15th, and this the more because I am thereby prevented from speaking to you personally on a matter which is of the very greatest importance to you and of the highest interest to me, namely, the accommodation and appliances in the above institution for teaching physics. I must say at once that I am making this representation without the knowledge of the professor of physics, and at the risk of causing him annoyance. The "preparation" room, which is shared between the professors of chemistry and physics, is a miserable hole. The "physical laboratory" which is on the basement, and paved with flags, is equally wretched. No cat with any self respect would consent to be swung in either. It must be almost impossible for any instrument of precision to be employed. Three-quarters of the professors' time must be wasted in making shift: in making bricks without straw. Time which, if employed as it should partly be in research, would bring honour to your city and your professors and students to your college. Is it fitting that in one of the centres of the industries which depend so completely on science, not so much is done for it as in many a boys' school? It is not fitting; but it is a reproach to the wealth, to the intelligence, and to the forethought of your citizens. If it is necessary that there should be in Newcastle a little scientific appendage to the University of Durham, be it so; but for pity's sake do not call it a college of physical science, and for your own sake let there be something better; something more in accord with the noble intellectual traditions of Newcastle.—Your obedient servant,

"'Frederick Guthrie.'

"If this language is strong, it is, sir, on that account all the more appropriate. Nothing can express the pain and disappointment I felt in seeing, as well as the light would permit, in what dens Professor Herschel has to work.

Granted that he has succeeded marvellously well with his students; if he can hop as fast as others run, I for one would like to see him run. I do not speak of the chemical laboratory, only because I am not officially cognisant of its defects. I have been told that the publication of my letter to the managers would put the "Newcastle back up." What on earth does it matter whether the back is up or down so that the shoulder is to the wheel. Newcastle is justly renowned for the energy and enlightenment of her sons, and she is destined to become as pre-eminent in her educational power as she is in mining, manufactures, and commerce. Let not another generation go by stained by indifference to the most solid and noble of all wisdom—wisdom in nature.—I am, &c.,

"Frederick Guthrie.

"24, Stanley Crescent, Notting Hill,
London, W., July 9, 1877."

CONTRIBUTIONS ON CHEMICAL ANALYSIS.

To the Editor of the Chemical News.

Sir,—During the past six or eight months the readers of the Chemical News have been edified by an extensive series of notes on various points of chemical analysis contributed by a M. Sergius Kern, of the Obouchoff Steel Works.

As a rule chemists are greatly obliged to anyone having extensive experience of a process who will publish the exact details of his method of working for the benefit of others, and on this account we ought to feel much obliged to M. Kern. Unfortunately, however, that gentleman's contributions contain little that is novel, and that little is mostly incorrect.

One of the most striking peculiarities of M. Kern's contributions is that many of the factors used for calculation are totally wrong. As an example of M. Kern's calculations I may mention that on page 1 of vol. xxxv., the pyrophosphate of magnesium is stated to contain 13·51 per cent of phosphorus, instead of 27·92, which is the correct amount. The wideness of the discrepancy suggests at first that M. Kern has made the mistake of calculating $Mg_2P_2O_7$ to P instead of to P_2, but in that case the percentage would have been 13·96 instead of 13·51, so that the error is not due to mere inadvertence. Again, on page 203 of the same volume, the same salt is stated to contain 36·04 per cent of magnesium instead of 21·82 per cent, which is the fact. As, however, the pyrophosphate really contains 36·04 of MgO, this mistake may possibly be a printer's error. But the same explanation will not apply to the wonderful error on page 67 of last volume, where Cr_2O_3 is stated to contain 32·2 per cent of chromium —the true amount being 69·0 per cent! This erroneous factor is employed by M. Kern on page 107 (of the same volume) for all his calculations of the percentage of chromium in chrome ores, with the consequence that the reported percentage is in each case less than half of the truth! Without going further, it is evident that calculations are not M. Kern's strong point, and the fact that on page 17 of volume xxxv. he points out that the amount of carbon contained in 1 c.c. of a solution is one-eighth of the quantity contained in 8 c.c., appears to show that he imagines other people to be on a par with him.

In his last contribution M. Kern claims to have discovered a new metal. As Russian chemists have special facilities for examining platinum ores, and Bunsen has *already* pointed out the probability of the existence of a new metal *in the very residue* in which "Davyum" is said to have been discovered, I am far from asserting that M. Kern's claim has not a sound basis. On the other hand, any discovery by a chemist of the analytical antecedents of M. Kern requires confirmation, especially as almost the only special character of "Davyum" hitherto noticed is its low specific gravity. With the above specimens of M. Kern's calculations before us, it seems probable that the density may be open to correction. The reactions of "Davyum" with acids and of its solutions with alkalies, sulphuretted hydrogen, &c., present nothing exceptional, while its reaction with sulphocyanide is not shared only by iron (as M. Kern appears to suppose) but is common also to uranium and ruthenium, and probably other metals.

In conclusion, I may say that unless the coal-gas in Russia is exceptionally crude in its nature the proposal to purify it by means of a solution of nitrate of lead in soda (with a view to remove H_2S and SO_2, and thus lessen the action on platinum vessels of the products of its combustion) made by M. Kern on page 77 of the last volume, appears to be based on a misconception.—I am, &c.,

A. H. Allen.

Sheffield, July 13, 1877.

BOILER INCRUSTATIONS.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xxxvi., p. 15) Mr. Edward Francis gives analyses of boiler incrustations. The three samples given are all instances in which calcium sulphate is the characteristic constituent. I fancy, however, in the majority of cases calcium carbonate will be found as the constituent predominating in boiler-deposits, although, of course, the nature of the deposit entirely depends upon that of the water used. The calcium carbonate being held in solution by an excess of free carbon dioxide is at once precipitated on the escape of this solvent, which is effected by heating the water. In the case of sulphate of lime, however, this can only be deposited in any quantity by supersaturation. The following are the results of analyses which I made some time ago of three samples of boiler incrustation in which calcium carbonate was the prominent constituent.

	I.	II.	III.
Calcium carbonate	71·75	75·90	80·5
Magnesium carbonate ..	7·41	7·81	4·6
Calcium sulphate	3·30	11·03	6·8
Silica	10·16	2·61	
Ferric oxide	1·86	0·65	8·1
Moisture, organic matter, &c.	5·52	2·00	
	100·00	100·00	100·0

Some time ago Mr. W. Johnson, of Edinburgh, kindly forwarded me the result of an analysis he had made of a sample of boiler deposit, in which silica curiously existed to the extent of 40·22 per cent. Below is his analysis:—

Silica	40·22
Calcium carbonate	2·24
Calcium sulphate	41·02
Ferrous carbonate	5·71
Calcium phosphate	1·74
Magnesium carbonate	9·07
	100·00

It would be very interesting to know the source of the water which gave rise to this deposit. Was the silica in suspension, or in solution in the water?—I am, &c.,

William H. Watson.

Braystones, near Whitehaven,
July 16, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 25, June 18, 1877.

Notation of Berzelius.—M. Berthelot.—The author points out that M. Wurtz is in error in asserting that Berzelius wrote the oxides and the chlorides as do the modern

atomists. He wrote all the oxides in the same manner, KO, NaO, PbO, CaO, instead of dividing them into two groups, K_2O and CaO. He expressed all the chlorides also in one and the same manner.

Certain Observations on the Mechanism of Chemical Reactions.—M. Berthelot.—The author has observed some novel facts regarding the direct oxidation of haloid salts and of the sulphurous and arsenious acids. The haloid salts, if slighly moistened, absorb ozone at the common temperature—a fact well known as regards iodide of potassium, which yields iodate of potassa and a little free iodine. It is the same with the chloride of potassium which produces chlorate, and with the bromide which yields bromate, though both in small quantity. The absorption of ordinary oxygen by iodide of potassium disengages heat, say + 44·1 for $IOGK$, and *a fortiori* the absorption of ozone. On the contrary, the conversion of chloride of potassium into chlorate by ordinary oxygen absorbs − 11·0, and that of bromide into bromate − 11·1. The superior energy residing in the ozone, +29·6 for O_6, a quantity greater than 11·0, is consumed by the direct synthesis of the chlorate and the bromate of potassa. In the case of sulphurous acid we find that the production of anhydrous sulphuric acid liberates—

$$SO_2 + O = SO_3 \ldots + 17{\cdot}2.$$

But this reaction, by means of dry bodies, does not take place at common temperatures, and even if the two gases are kept in contact at 100° for forty-eight hours we have still no indication of combination. But if water is added the reaction is gradually effected, and the dissolved sulphurous acid is converted into sulphuric acid. This corresponds to a liberation of heat double that of the former—SO_2 dissolved + HO + O = SO_3HO dissolved + 32·2. Even in the cold, when dry sulphur and oxygen (or rather ozone) combine under the influence of the electric effluve, a certain quantity of anhydrous sulphuric acid is also produced.

Crystalline Form and the Optical Properties of the Proto-iodide of Mercury.—M. Des Cloizeaux.—The crystals of this salt belong to the quadratic system, but might be mistaken for a clino-rhombic combination, in consequence of their very strong flattening on the two parallel faces of the fundamental square prism, and of the very unequal development of the surfaces of the octahedron a^1. The measurement of their angles yields numbers almost identical with those received for the proto-chloride of mercury (*calomel*), so that the two salts offer the most complete geometrical and optical isomorphism. It is worthy of remark that they are also geometrically isomorphous with the red biniodide of mercury.

Electro-magnets with Iron Shields.—M. Th. du Moncel.—This paper will, if possible, be inserted in full.

New General Method for the Synthesis of Hydrocarbides, Acetons, &c.—Second note by MM. Friedel and Crafts.—The reaction described in the authors' former paper is also produced when derivatives of the alcohols of the aromatic series are substituted for those of the fatty series. The chloride of benzyl readily reacts upon benzol in presence of chloride of aluminium, yielding benzyl-phenyl.

Reducing Action of Phosphorus upon Sulphate of Copper.—M. Sidot.—The author has allowed sticks of phosphorus to lie for some months in a cold saturated solution of sulphate of copper, and has obtained a series of copper tubes, the outer surface of which was covered with fine octahedral crystals of the metal. In this reaction the water is decomposed, metallic copper and phosphide of copper are formed, whilst sulphuric and phosphoric acids remain in the liquid.

Crystalline Carbonate of Lead formed upon Objects found at Pompeii.—M. S. de Luca.—Brilliant, well-defined crystals of carbonate of lead are found among the opaque amorphous variety. Their formation is not clearly accounted for.

Observations on certain Xanthates: Separation of Cobalt and Nickel.—Dr. T. L. Phipson.—Already inserted.

MISCELLANEOUS.

Award of the Lavoisier Medal.—The Lavoisier Medal of the Société d'Encouragement pour l'Industrie Nationale has just been given to an Englishman, Mr. Walter Weldon, F.R.S.E. In presenting it M. Dumas congratulated Mr. Weldon upon having cheapened every sheet of paper and every yard of calico made in the world; and at the meeting at which the presentation took place Prof. Lamy stated that whereas at the date of the introduction of Mr. Weldon's invention, seven or eight years ago, the total bleaching-powder made in the world was only about 55,000 tons per annum—it is now over 150,000 tons per annum; and that of this vast quantity fully 90 per cent is made by the Weldon process. The Lavoisier Medal had been awarded only once before, namely, in 1870, to M. Henri Sainte-Claire Deville. The only other recipients of this Society's "Great Medal," which bears different effigies according to the class of service for which it is given, are Ferdinand de Lesseps, Boussingault, Jaques Siegfried, Henri Giffard, and Sir Charles Wheatstone.

NOTES AND QUERIES.

Water Analysis.—I have frequently found on testing samples of water for the presence of metals that the ammonium sulphide hydrate produces a colouration when no metal is present, and which disappears on boiling. Will any of the readers of the CHEMICAL NEWS kindly explain the cause of the reaction?—R. L. HAWKINS, Hastings.

THE
QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c

Now ready No. LV., *July*, 1877, price 5s.

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V. On the Present Condition of Chile.

Review of Dr. Carpenter's work on "Mesmerism, Spiritualism, &c." By Alfred Russel Wallace.

Notices of Scientific Works, Scientific Notes, &c.

London: 3, Horse-Shoe Court, Ludgate Hill, E.C.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Office of Assistant General Secretary will shortly be vacant. Particulars of the new appointment and duties may be obtained on application at the Office of the Association, 22, Albemarle Street, London, W. Candidates are requested to send in their names to the General Secretaries, 22, Albemarle Street, with any attestation of their qualifications they may think desirable, on or before the 28th instant.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 22, Albemarle Street, W.—The NEXT ANNUAL GENERAL MEETING of the Association will be held at PLYMOUTH, commencing on WEDNESDAY, August 15.

President-Elect.

Prof. ALLEN THOMSON, M.D., LL.D., F.R.S., F.R.S.E.

NOTICE to CONTRIBUTORS of MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several Communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 1, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section ....." If it should be inconvenient to the Author that his Paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G. GRIFFITH, M.A.,
Assistant-General Secretary, Harrow.

THE CHEMICAL NEWS.

Vol. XXXVI. No. 922.

ON REPULSION RESULTING FROM RADIATION.—PART IV.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 26.)

188. The past summer and autumn have been very unfavourable for spectrum researches of this character. My first accurate experiments with the above-described apparatus were tried on July 26, and between that date and the middle September the apparatus was kept in good adjustment, so that use could be made of the comparatively few occasions when the sun was sufficiently clear. I find that, owing probably to a variation in the aqueous vapour in the atmosphere or to slight haze, the observations of one day are not readily compared with those of another. Isolated experiments on one part of the spectrum are therefore of slight value, and my endeavour has been to embrace as wide an extent of spectrum each morning as I was able. A cloudless sky is not always the clearest. The best results seem to be obtained when there is a moderate amount of wind, and great white clouds are floating about. The method of observation was as follows:—Having adjusted the scale so that the index ray of light pointed to zero, and having brought the particular part of the spectrum I wished to examine opposite the aperture in the screen, I opened the shutter and watched the progress of the luminous index until it reached its furthest point, when the shutter was closed. As the scale was divided into millimetres, the number of these traversed by the index was taken as the value of the part of the spectrum which shone on the pith. The piece of pith was 13 millims. square; consequently each number so obtained must be considered the average of a portion of the spectrum 13 millims. long.

189. I give below the actual results as they were obtained.

Date.	Portion of Spectrum thrown on to pith.†	Deflection of index ray of light.	Observations.
		millims.	
July 26.	C	25	
,,	D	19	
,,	E	12	
,,	b	8	
,,	F	5	
,,	between F and G‡	2	
29.	C	61	
,,	D	34	
,,	b	12	
,,	F	9	
Aug. 4.	A	23	Sky hazy, and light varying very much.
,,	B	24	
,,	C	35	
,,	between C and D	27	
,,	D	15	
,,	b	10	
5.	between B and C	40	
,,	D	29	
,,	between D and E	24	
,,	b	17	
,,	F	10	
,,	between F and G	6	
,,	G	3	
,,	H_1	2	The sun was very bright and powerful. All the observations were taken between 12 noon and 1 p.m.
13.	ultra-red	147	
,,	,,	121	
,,	B	105	
,,	between C and D	75	
,,	,, ,,	65	
16.	between A and B	96	
,,	D	80	
,,	between D and E	57	
,,	b	33	Sun very bright. No clouds.
,,	F	25	
,,	between F and G	16	
,,	,, ,,	12	
,,	G	5	
17.	just below A	90	
,,	C	65	
,,	just above C	64	
,,	D	63	Sun very bright, but small hazy clouds floating about.
,,	b	48, 42	
,,	F	35	
,,	between F and G	17	
,,	G	11	
,,	H	9	
31.	just below A	205	White clouds in patches. Sun occasionally obscured. Could not work after noon.
,,	C	155	
,,	between D and E	110	
,,	,, ,,	85	
,,	E	67	
,,	F	40	
,,	between F and G	13	
Sept. 1.	ultra-red	35	
,,	,,	133	
,,	,,	170	
,,	,,	190	
,,	,,	127	
,,	A	113	Sun very bright, but large white clouds floating about. Observations taken during clear intervals.
,,	B	102	
,,	between C and D	79	
,,	,, ,,	77, 75	
,,	between D and E	59	
,,	b	34	
,,	F	23	
,,	between F and G	14	
,,	,, ,,	13	
,,	,, ,,	12	
,,	H	9	
10.	ultra-red	21	
,,	,,	100	Sun quite bright up to 12.30 p.m., then the sky became rather hazy.
,,	,,	169	
,,	,,	215	
,,	C	149	
,,	E	82	
,,	F	29	
16.	E	88	Perfectly clear sky.
,,	F	47	
,,	G	18	
,,	H	13	
,,	ultra-violet	11	

* A Paper communicated to the Royal Society, February 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

† The lines were caused to fall on the exact centre of the pith. Consequently the action is caused by the portion of the spectrum 6½ millims. on each side of the portion here designated.

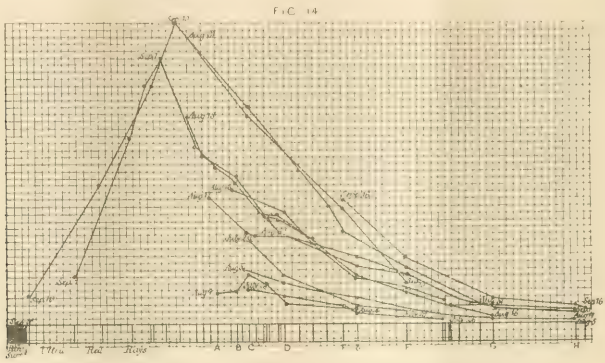
‡ The exact position of the central line falling on the pith was in this and similar cases carefully taken and marked on a diagram (see fig. 14).

190. In Fig. 14, which is reduced to half the linear scale, I have attempted to show the above results graphically. The horizontal band, crossed by vertical lines, at the lower part of the figure represents the solar spectrum. The vertical lines to which letters are attached are the

Fraünhofer lines. The other lines do not represent spectrum-lines, but are put there to mark the parts of the spectrum at which observations were taken. The spectrum is of half the length which I used in the experiments, and the lines are also to scale. The square black portion at the left extremity shows the relative size of the pith surface in the torsion-apparatus.

The dots scattered about the upper portion of the figure, when measured from the upper horizontal line bounding the spectrum, give the millimetres traversed by the index ray of light when the portion of the spectrum corresponding to the dot fell on the black pith. Observations taken the same day are connected by lines; the date of observation is written at the beginning and end of the line. The curves thus formed may be regarded, therefore, as a measure of the intensity of the radiation.

FIG. 14



Although there is a general resemblance between the curves taken on separate days, inasmuch as they all approach a maximum at a point somewhat below A, and then diminish on each side, the incline being steeper on the ultra-red than on the blue side, yet there is scarcely any resemblance between the heights of the curves on separate days. There are two causes for this. The first is that the weather was not always so favourable as I could wish; but having waited so long, I took observations at first whenever I could get an opportunity. Thus the first four days, July 26 and 29, and August 4 and 5, were not quite clear, and the curves consequently have but slight gradients; they form a group by themselves. Afterwards I became more critical, and would not attempt spectrum observations unless there was a good chance of a very bright sun. Consequently the curves on the next three days, August 13, 16, and 17, show an improvement in altitude. Having got these results, I determined not to try any more unless the weather were exceedingly favourable, and then to work principally at the extreme ends of the spectrum. The curves of August 31, September 1, 10, and 16 show, in consequence, much greater elevations.

The second cause which may possibly account in some measure for the differences in the curves, is that, as the apparatus was kept exhausted week after week with the pump working almost daily, the pith may have become drier, the aqueous vapour may have become more perfectly removed, and the vacuum consequently more nearly absolute.*

(To be continued.)

* I could not exhaust this apparatus with charcoal (131) owing to the cement joints.

NOTES ON THE ELECTRIC AND CHEMICAL DEPORTMENT OF ARGENTIC SULPHIDE.

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

IN a paper I have given* on the "Conducting Power of Sulphides," it is stated that argentic sulphide is a good conductor of electricity for a sulphide. I find, however, since this table was compiled that the deportment of this substance into electric currents is a subject which has given rise to some controversy, and that the results as published leave a uniform impression upon chemists that argentic sulphide is not an electric conductor in the sense this is usually and properly taken—*i.e.*, not a conductor as a metal is without decomposition.

Thus Professor Faraday supposed it "conducts electricity like a metal, without decomposition; its conducting power, however, increasing with rise of temperature;" while Hittorf is said to show "that, when this compound is free from metallic silver, it conducts only in proportion as it is decomposed."

A knowledge of these conflicting opinions, and of the fact that their tendency is, as the matter now rests, one of antagonism to that of my own opinion on the subject just quoted, induced me to repeat the experiments upon which my opinion was founded, and with such modification as I thought might best conduce to results informing us correctly on this subject. Taking three plates of pure silver, which had been thickly enfilmed with this sulphide, by twenty-four hours immersion in a strong solution of sodic sulphide, I well washed and thoroughly dried them, but without disturbing these films; then placed them gently on each other, and connected the outside ones with a feeble battery of one cell, which was attached to a galvanometer, when I found an electric current was still indicated, and which was not notably less in quantity than that which was indicated when these plates were out of the circuit.

The same result followed when the silver plates were heated to 300° F. and even used in this experiment while at a temperature approximating to this.

I therefore conclude that argentic sulphide can be, as I have maintained, a conductor of electricity, and, for a sulphide, a very good one.

Regarding the chemical deportment of this substance (argentic sulphide), I find, contrary to what is alleged respecting it, that it is soluble in cyanide of potassium,

* *Trans. N.Z. Inst.*, vol. iv., art. li.

and at common temperatures, and I may state in this connection that auric sulphide is also soluble in this salt; platinic sulphide appears scarcely so, even in a hot solution of it, though sulphur is detectable in this solution afterwards by the nitro-prussic test.

I further find that argentic sulphide is not, as heretofore supposed, unattacked by mercury, but is decomposed, though very slowly by it, mercuric sulphide resulting, attended by amalgamation of the silver thus liberated. Auric sulphide is also very slowly decomposed in the same way; plumbic sulphide, however (as galena), is not.

It will be seen, therefore, that these sulphides in their deportment with mercury behave exactly as we should expect from the electrolytic results I have given in respect to them in my paper on the "Electro-motive Power of Gold and Platina in Sulphides,"* both silver and gold being there stated to be negative to mercury in sulphide of sodium, and lead positive thereto. Indeed I may state that it was the knowledge of the electrolytic behaviour of the metals above named which induced me to try for the decomposition of argentic and auric sulphide by mercury.

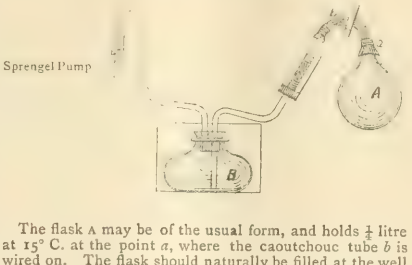
In this connection I would further inform you that this sulphide (argentic) appears decomposed by chloride of copper alone, although it is stated not to be affected by this salt, except in the presence of an alkaline chloride. Theoretically, indeed, it should be decomposed by this cupric salt unaided, as sulphur has a greater affinity for copper† than it has for silver, and chlorine has a greater affinity for silver than for copper. There is no doubt, however, that the forming of this chloride of silver stops the action at a point at which we cannot readily distinguish that any action has taken place.

ON THE ESTIMATION OF THE GASES DISSOLVED IN WATER.

By J. W. THOMAS.

THE method generally used for determining the quantity of the gases dissolved in water is a modification of Bunsen's, which is too well known to require much description. After the air in the connecting tube, dipping under the surface of mercury, has been removed by converting a portion of the water in the intermediate bulb into steam, the clamp of the flask is opened, and by the application of heat the gases are given off. A no inconsiderable portion of water passes down the connections, and in many instances, unless the greatest caution is exercised, the water in the connections and the gases evolved from the water in the flask rush over suddenly, and not unfrequently fill the collecting tube in the mercury trough to overflowing. In any case, however, it is impossible to collect the gases without a very appreciable quantity of water coming over with them, and this is cooled by passing through the mercury. If the quantity of gas is small it often happens that CO_2 can scarcely be detected. About eighteen months ago I examined some chalybeate waters and estimated the dissolved gas, but was surprised to find so small a quantity of CO_2. On subjecting the water in the collecting tube to the expanding influence of a long column of mercury in a gas apparatus a very appreciable volume of gas was obtained. This loss of gases through the presence of water in the tubes in which they are collected has been verified on numerous occasions during the carrying out of some recent experiments.

The method which I used for collecting the gases from the waters referred to was by the aid of the Sprengel pump, using a large bulb on the Sprengel connecting tube, and a calcic chloride tube to dry the gases before they passed over. I have since found that there is very little necessity for using a drying tube, and the apparatus I now employ is simply that shown in the sketch.



The flask A may be of the usual form, and holds ¼ litre at 15° C. at the point *a*, where the caoutchouc tube *b* is wired on. The flask should naturally be filled at the well or source from whence the water is taken, and the gases estimated as soon as possible. The caoutchouc tube joined to the flask A should have very thick walls, and is connected before the flask is filled with water, after which the tube is tightly pressed from the mouth of the flask A outwards, so as to remove the excess of water, and then securely clamped; if the temperature of the water is very low, and it has to be taken to a distance, pack the flask in sawdust with a small lump of ice at the bottom. The flask B holds about 150 c.c., and is of the form shown; the oil vessel of a "needle lubricator" answers well. B is fitted with an india-rubber stopper, well tapered, and pierced with two holes, through which passes a long tube in B, reaching within one-half inch of the bottom and forming the connection for the flask A, and the other tube simply passing through the stopper and forming the connection with the Sprengel. B is immersed in a beaker of water below the stopper.

After a vacuum has been formed, which will take about twenty-five minutes with a good pump, the clamp on A is quickly opened. If the vacuum remains but little impaired, owing to the gases dissolved being small in amount, shut off the pump, and by the application of heat drive off some of the water in the flask A until the end of the long tube in B is just covered with it; then start the pump, and the gases will be brought over remarkably free from water. If the quantity of gas present is large, exhaust some of it before applying heat to A, until the pellets of Hg in the Sprengel fall through some distance; then apply heat, working the pump slowly until the water in B covers the end of the tube; the vacuum should not be very complete until this is effected. After a little practice it is surprising how free from water the gases can be obtained, but if care is not taken it is better to introduce a $CaCl_2$ tube between the flask B and the Sprengel. The beaker under B can be heated at the close of the operation in order to remove any traces of gas re-dissolved in the water which B contains, first removing the *collecting* tube and replacing by another in case any water should get over. I have tried the experiment three times, but in no instance did I obtain 0·2 c.c. of gas.

Little need be said regarding the subsequent treatment of the gases—they may be collected in a graduated tube of known volume and analysed by absorbing with liquid reagents, keeping the tube well agitated for five minutes during each operation; removing the liquid reagents by a plug of moist cotton-wool on the end of a wire, and letting the tube stand for twenty minutes in order to measure the volume; or, what is a more expeditious method, if a gas apparatus is at hand, measure and analyse a small portion of the gas first, and if the result is satisfactory measure the remainder; then the sum of the two portions multiplied by 4 will give the total dissolved gases per litre.

* *Trans. N.Z. Inst.*, vol. iv., art. liii.
† *Ibid.*

REPORT

ON THE METHODS EMPLOYED IN THE

ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,

AND ON THE

MODE OF STATING THE RESULTS.*

(Continued from p. 18.)

ONE very considerable advantage attaches in practice to Tatlock's method which is not shared by the others. In consequence of employing an aqueous liquid at first, any sulphates present can readily be washed out, and therefore there is no occasion to separate any moderate amount beforehand.

The influence of sulphates is well shown by the following results by Tatlock's method :—

TABLE VIII.

82 *Per Cent* KCl + 18 *Per Cent* Na_2SO_4.

Expt.	=KCl.	=KCl found per 100 parts taken.	
64.	0·697	100·13	P.
65.	0·697	100·25	

TABLE IX.

K_2SO_4 *with sufficient* NaCl (0·5 *grm.*) *to ensure the reaction* $K_2SO_4 + 2NaCl + PtCl_4 = K_2PtCl_6 + Na_2SO_4$.

Expt.	$=K_2SO_4$.	$=K_2SO_4$ found per 100 parts taken.	
66.	0·70163	99·51	
67.	0·70009	99·67	W.
68.	0·70226	99·57	
†69.	0·70255	99·78	W.
70.	0·70087	99·80	

The next experiments were made to ascertain the effect of employing hydrochloric acid instead of chloride of sodium according to the reaction—

$$K_2SO_4 + 2HCl + PtCl_4 = K_2PtCl_6 + H_2SO_4.$$

In Experiments 71, 72, 73, 2 c.c. of hydrochloric acid were employed; in Experiments 74, 75, 2½ c.c. were used. The acid in each case had a density of 1·11.

TABLE X.

Expt	K_2SO_4 taken.	K_2SO_4 found per 100 parts taken.	
71.	0·70419	99·66	W.
72.	0·70173	99·11	
73.	0·70427	99·23	W.
74.	0·70132	99·71	
75.	0·70141	99·72	W.

In the first three experiments the quantity of HCl appears to have been insufficient to effect complete conversion, but in the latter experiments the reaction seems to have been more perfect.

The following experiments were made in illustration of the use of Tatlock's process in the analysis of a German muriate, which was represented by a mixture containing 85 per cent KCl, 10 per cent $MgSO_4$ (anhydrous), and 5 per cent NaCl :—

TABLE XI.

Expt.	KCl taken.	KCl found per 100 parts taken.	
76.	0·5949	99·999	
77.	0·5947	99·910	W.
78.	0·5951	100·120	

A mixture containing 50 per cent KCl, 25 per cent NaCl, and 25 per cent $MgSO_4$, was found by Mr. Galbraith to contain 99·83 per cent of KCl for 100 introduced, equal to 49·915 per cent in the actual sample.

In many of the experiments detailed it must be remembered that the actual departure from the truth is only a fraction of what it appears to be on calculation to 100 parts. Thus, in the above tables, the results are compared with 100 parts of the potassium salt taken, whereas in practice the results would be stated on 100 parts of the sample. Hence, in a mixture of equal parts of the chlorides of potassium and sodium, to obtain 100·5 parts of KCl instead of 100, would be expressed in practice by stating the sample to contain 50·25 of KCl and 49·75 of NaCl, thus reducing the actual error to half what it appears to be in some of the tables. This view finds expression in Table V.

The next experiments were made by Tatlock's method on pure nitrate of potassium, to which was added enough chloride of sodium (0·42 grm.) for the reaction—

$$2KNO_3 + 2NaCl + PtCl_4 = K_2PtCl_6 + 2NaNO_3.$$

TABLE XII.

Expt.	Weight of Solution.	$=KNO_3$.	Weight of Precipitate.	KNO_3 found.	$=KNO_3$ Per cent.	
81.	7·7090	0·70082	1·6868	0·69879	99·72	
82.	7·7330	0·70300	1·6944	0·70212	99·87	W.
83.	7·7325	0·70296	1·6953	0·70249	99·93	

It appears, therefore, that Tatlock's process is applicable to the analysis of sulphates or nitrates, provided that there is sufficient chloride present for the formation of chloro-platinate of potassium. If not, it must be added in the form of sodium chloride, or in the case of sulphates hydrochloric acid may be used. When much sulphate is present the quantity of platinum solution used for washing the precipitate must be somewhat increased, or the results will be too high, owing to the insolubility of the sulphates in alcohol. Magnesium appears to cause no difficulty, the result 99·999 having been obtained in its presence.

When it is remembered that none of the foregoing experiments were made on a larger quantity than 0·7 of a grm. (about 10 grains), it will be seen that the determination of potassium as chloro-platinate is, when due care is taken, as accurate as the estimation of most elements, and when heavy metals are present quite as easily effected.

In practice it is rarely required to determine potassium very accurately in the presence of large proportions of foreign metals, but in the accurate assay of the better class products is becoming daily more important. If the proportion of sodium salts present in a sample exceeds 3 per cent the product is unfit for certain purposes, and as the determination of the sodium is strictly dependent on that of the potassium, any error in the latter is reproduced.

Although the results obtained by Tatlock's method show a decided loss when a very large proportion of chloride of sodium is present, this error nearly disappears with smaller amounts, and as the method is available in the presence of sulphates, nitrates, and magnesium, and is very readily conducted, it seems the best suited for the general assay of commercial potassium salts.

From a general consideration of the foregoing researches on the determination of potassium as chloro-platinate it appears that :—

(1.) Potassium in the form of pure chloride can be determined with great accuracy by precipitation as chloro-platinate. If a large excess of platinum solution be employed, and alcohol only used for washing the precipitate, the results have a tendency to exceed the truth. By avoiding the use of a large excess of platinum solution more accurate results are obtained. If a small volume of platinum solution be employed in the first instance for washing the precipitate (as recommended by Tatlock), and the washing then completed with alcohol in the usual way, the results are very accurate. Potassium chloro-platinate appears to be practically insoluble in a concentrated solution of platinic chloride.

* Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

† The precipitate obtained in this experiment, after drying at 130° C., gave 99·72 per cent of K_2SO_4, per 100 parts taken.

(2.) In presence of a considerable proportion of chloride of sodium, washing the precipitate with alcohol alone tends to give results in excess of the truth. If the precipitate be first treated with platinum solution the results are somewhat low, apparently owing to the solubility of the precipitate in solution of sodium chloro-platinate: the error increases with the amount of sodium, but is never very large, and a correction may be applied if desired.

(3.) If Tatlock's method be employed there is no occasion to separate any sulphates, nitrates, or magnesium, but if the amount of chloride present is insufficient for the existence of all the potassium as chloride of potassium, the deficiency must be supplied by the addition of chloride of sodium or hydrochloric acid. The results obtained are in many cases very accurate, but have a tendency to be somewhat below the truth.

(4.) There is practically no advantage in drying chloroplatinate of potassium at 130° C. rather than at 100° C.; the loss at the higher temperature was found to exceed 0·07 per cent of the weight of the precipitate, but is probably governed by the conditions of precipitation.

(5.) The Committee is of opinion that a preliminary washing of the precipitate of chloro-platinate of potassium with a solution of platinic chloride is a valuable modification of the usual process. As the method so modified is capable of direct application to the commercial salts of potassium, and does not necessitate the removal of sulphates, nitrates, or magnesium, the Committee considers that it deserves to be generally applied to the determination of potassium in commercial products containing it.

So far the Committee has not thought it necessary to make any experiments on other methods of determining potassium than that in which it is converted into chloroplatinate.

(To be continued.)

RUSSIAN SCIENTIFIC NEWS.

At a recent meeting of the Russian Physical Society M. Gesechus made some remarks on the elasticity of metallic palladium. Preliminary experiments showed the coefficient of elasticity to be 16,000 (platinum = 17,000). Hydrogenated palladium (Pd_2H) has a rather lower coefficient = 14,400; this number remained the same even after three or four days, when a certain quantity of hydrogen was liberated. The diminution of the palladium wire could be observed for more than ten days.

M. Tchicaleff has executed during last winter interesting experiments on the intensity of the electric light in the open air. Magneto-electric machines of Altenec were used. The eye could not detect much difference in the lights of two machines—one equal two 10,000 candles, the second 4000 candles—notwithstanding that in the first case a refractor was used and in the second a reflector. During these experiments the advantage of carbon candles covered with galvanic copper was again proved; ordinary carbons burned for a length of 0·07 metre, while the carbons covered with copper burned for a length of 0·01 metre.

M. Grabowsky, of Kazan, has made some experiments with soap manufactured in Russia, and obtained the following results:—

1. Soap prepared from oleic acid contains less water than soap manufactured from solid fats (stearic acid).

2. With the decrease of the melting-point of the acids used in soap manufacture the dissolving power increases.

3. In soaps prepared from solid fat acids more than a third by weight is lost without any use when the soap is used for washing purposes.

At the same time the author proposes to use solid fat acids for the manufacture of candles, and the oleic acid for the preparation of soap; the resulting soap is easily soluble in water.

A peculiar hypothesis has been proposed by Professor D. J. Mendeleeff on the formation of naphtha in nature. In sandstones, where a great quantity of mineral oil is often found, there is no presence of organic deposits or of great quantities of coal or lignite. The author thinks that in all cases it is difficult to suppose that the formation of naphtha is due to the destruction of organic matter. M. Mendeleeff explains the formation of naphtha by certain reactions of mineral substances, viz., metallic carburets. In the interior of the earth abundant quantities of metallic carburets are supposed to exist, which, by the action of water under high pressure and temperature, give metallic oxides and primary hydrocarbons (C_nH_{2n+2}). The hydrocarbons volatilise and condense in the superincumbent sandstones, which are spongy enough to condense great quantities of the mineral oil. Numerous experiments have been commenced by the Professor, which, when finished, will have a high interest for the chemist and geologist.

SERGIUS KERN.

Obouchoff Steel Works, St. Petersburg.

PROCEEDINGS OF SOCIETIES.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

July 9th, 1877.

Professor C. LIEBERMANN, Vice-President, in the Chair.

DR. F. TIEMANN and P. KOPPE exhibited and described an "*Apparatus for the Determination of Free Oxygen in Water*," being essentially a simplification of Schützenberger's method. It consists of a flask from which the air can be expelled by a stream of hydrogen, connected with two burettes. One contains a solution of indigo and the other a solution of hydrosulphite of soda. The strength of the latter solution is obtained by comparison with a normal solution of a cupric salt. After expulsion of the air from the flask, a given quantity of the indigo solution is admitted, and sufficient hydrosulphite of soda added to decolourise the solution. A measured quantity of the liquid containing free oxygen is then admitted. The blue colouration which ensues is then removed with the solution of hydrosulphite, the amount required corresponding to the amount of oxygen present. A moderate temperature is maintained during the operation. The process yields very accurate analytical results.

C. O. CECH, describes a peculiar "*Action of Taurin in the Organisms of Birds.*" It has already been noticed that taurin in the human and canine organisms changes into the corresponding uramido acid, while in the urine of rabbits it gives rise to hyposulphurous and sulphuric acids. The author finds, on the contrary, that in birds which have been fed on taurin, a notable increase in the amount of H_2SO_4 takes place, unaccompanied, however, by uramido, hyposulphurous, or sulphurous acids. In order to explain the decomposition of the taurin urea was sought for, but in vain. A large increase in the amount of uric acid was, however, noticed, leading to the conclusion that the urea formed by the decomposition was changed in the organisms of birds into uric acid. This assumption was confirmed by feeding fowls on urea, observation showing that the urea was changed completely into uric acid during the passage through the organism.

The same author describes the "*Preparation of Dichloracetanilide*," which he obtains from dichloracetic acid and aniline by digestion with phosphoric anhydride, and from ethylic dichloracetate by first changing it into the amide and then digesting with aniline.

H. Herzfeld. "*Derivatives of Paroxy-benz-aldehyd.*" Among these are paroxy-benzyl alcohol,—

$$C_6H_4(OH)CH_2OH,$$

obtained by reducing the aldehyd with sodium amalgam, hydro-paroxy-benzoin, $C_{14}H_{14}O_4$, obtained by dilution of the solution in the preceding preparation, and nitro-paroxy-benz-aldehyd, resulting from the action of H_2SO_4 and HNO_3. The aldehyd unites with ammonia to form an oily unstable compound, containing 1 molecule of each constituent. It unites also with a molecule of aniline under separation of water and formation of a crystalline compound. Salicylic aldehyd forms an oily compound with ammonia analogous to that derived from paroxy-benz-aldehyd.

The following communications have been received from non-resident members:—

W. Zorn, "*Nitroso-silver.*" The yellow compound obtained by Meyer and regarded as possessing the formula $Ag_2O_3N_2O$ is found to be really nitroso-silver, AgNO, and forms nitroso derivatives with organic bodies.

A. Classen, "*Separation of Iron from Nickel and Cobalt.*" The author states the conditions under which Wöhler's method (Chemical News, vol. xxxv., p. 141) succeeds best. If the iron is present as a ferric salt, and the solution is neutralised the addition of acetic acid and potassium oxalate, causes a complete precipitation of nickel and cobalt, and separation from iron.

M. Landolf proposes the use of "*Boron Fluoride as a Dehydrating Agent*" in the synthesis of organic compounds. From camphor he obtains a body containing no oxygen.

O. Wallach and F. Oppenheim, "*On the Bases* $C_nH_{2n-3}ClN_2$." The authors examine first chloroxal-ethylin, $C_6H_9ClN_2$. Sodium acts on the base when dissolved in petroleum, causing the formation of an amorphous body, dioxal-ethylin, $C_{12}H_{18}N_4$. By the action of bromine on the solution of the base in chloroform two Br derivatives are formed, the formulæ of which an ingenious series of analyses shows to be—

$$C_6H_8ClBrN_2.Br_2.BrH,$$

and $C_6H_8ClBrN_2.Br_2$. Both are obtained as red crystals and are changed by water into bromo-chloroxal-ethylin, $C_6H_8ClBrN_2$, in which base the bromine is as firmly united as the chlorine.

I. Remsen, "*Xylol-sulphamides.*" Some additional facts are added to the author's late investigations in this field. He announces further the intention of investigating the conditions which prevent a complete decomposition of the molecule when ternary derivatives of benzene are oxidised. Most of these have yielded hitherto the simplest oxidation products.

C. L. Jackson and W. Lowery, "*Para-bromo-benzylic Compounds.*" Starting from para-bromo-benzyl bromide the authors have prepared para-bromo-benzylic alcohol, $C_6H_4BrCH_2OH$, crystallising in colourless needles; para-bromo-benzyl acetate, a heavy oil; and para-bromo-benzyl cyanide, yellow crystals melting at 46° and possessing a strong odour. This cyanide is changed by treatment with HCl into para-brom-alpha-toluylic acid, $C_6H_4BrCH_2COOH$, white needles melting at 114°. Alcoholic ammonia changes para-bromo-benzyl bromide into tripara-bromo-benzylamin, $(C_6H_4BrCH_2)_3N$, melting at 78°. A sulpho-cyanate, $C_6H_4BrCH_2SCN$, was also obtained, melting at 25°, and very soluble in alcohol.

W. Hammerschlag, "*Bromine Derivatives of Anthracen.*" The tetra-bromanthracen of Graebe and Liebermann was changed by the action of Br vapours into tetra-bromanthracen tetra-bromide—colourless prisms—which, upon heating at 230°, yield penta-bromanthracen, $C_{14}H_5Br_5$. This forms a yellow powder, melting at 212°, and is changed by oxidising agents into tribromanthraquinon. The tetra-bromide forms upon treatment with alcoholic soda hexa-bromanthracen, $C_{14}H_4Br_6$, a yellow crystalline body, very insoluble in most solvents. This appears to be the limit of bromine substitution in anthracen. Oxidation changes the compound quantitatively into tetra-bromanthraquinon, also an exceedingly insoluble body. Fusion with HNaO yields alizarin.

H. Vohl defends himself against a criticism of R. Fresenius on his statement "that water which contains alkaline bicarbonates and ferrous oxide in solution as well as ferric hydrate in a state of suspension does not admit of an evolution of H_2S," by a comparison of well-known mineral springs.

B. W. Gerland finds that the "*Separation of Vanadic Acid from the Alkalies by Means of Ammonium Vanadiate*" is always imperfect when potassium is present, the precipitate invariably containing small portions of the latter. This is not the case with sodium, however. Other salts of vanadium, such as the sulphates, manifest this property of obstinately retaining small quantities of potash. Ammonium is likewise retained in the same way by certain vanadium salts.

A. Ladenburg and T. Engelbrecht, "*Derivatives of Thymol.*" Dinitro-thymol was changed into the ethyl ether; this was reduced into the corresponding diamido compound, and then changed by oxidation into oxythymo-quinon. By treatment with PCl_5 dinitro-thymol was changed into dinitro-chloro-cymene, $C_{10}H_{11}ClN_2O_4$, which, after reduction, yielded upon oxidation oxythymo-quinon and chloroxythymo-quinon, $C_6CH_3C_3H_7O_2OH.Cl$. The latter yields, upon treatment with potash, dioxythymo-quinon or thymozarin, $C_{10}H_{12}O_4$. This body is also obtained directly from oxythymo-quinon by boiling with HOK. Theoretical considerations follow in support of the author's opinion that benzene contains two pairs of symmetrically united hydrogen atoms.

E. Schunck and H. Rœmer find that "*Anthraflavon,*" the condensation product of meta-oxy-benzoic acid, consists of anthraflavic acid, small quantities of a body dissolving with a purple-red colour in H_2SO_4, and a new compound, meta-benz-bioxy-anthraquinon, which melts at 293°, and yields a colouring matter on treatment with potash. No trace of iso-anthraflavic acid was detected.

J. Philipp, "*Action of Metallic Salts on Ultramarine.*" In order to settle the question as to whether other metals can be substituted for the sodium in ultramarine, and whether the commercial article is a definite chemical compound or a mixture of a distinct compound with other silicates, the author has first submitted ultramarine to the action of zinc sulphate. Experiment showed that the substitution of zinc for sodium was always confined within certain limits, about half the amount of the latter being replaced. The colour was scarcely altered, but the resulting compound was easily attacked by KOH, Zn being replaced by K, and a certain amount of SiO_2 and Al_2O_3 being removed. The reactions would seem to indicate that ultramarine contains a fixed compound not attacked by Zn, accompanied by silicates into which Zn can be introduced. $AgNO_3$ causes, however, a complete replacement of Na by Ag in both of the constituents of ultramarine.

H. Ekstrand obtains "*Trinitro-naphthol,*"—

$$C_{10}H_4(NO_2)_3.OH,$$

by the action of HNO_3 and H_2SO_4 on α-dinitro-naphtol (Manchester yellow). The compound and its salts crystallise finely, and possess more brilliant tinctorial properties than the dinitro-naphthol.

H. Weber has prepared, among other "*Derivatives of Dioxy-naphthalen,*" dibenzyl-, dibenzoyl-, and dimethyl-dioxy-naphthalen.

H. Diehl, "Cl *and* Br *Derivatives of Anthracen.*" By treatment with $SbCl_5$ octo-chlor-anthracen, penta-chlor-anthrachinon, and tetra-chlor-alizarin have been prepared. The corresponding Br derivatives have also been obtained.

H. Zetter, "*Halogen Derivatives of Phenanthren.*" The octo-chloro- and the hepta-bromo-phenanthren were the most highly substituted compounds obtained.

G. Ruoff, "*Halogen Derivatives of Aromatic Bodies.*" Rosanilin hydrochlorate yields with 1Cl, CCl_4, and C_2Cl_6 only. These two bodies, as well as C_6Cl_6, result from

the action of $SbCl_5$ on chrysen. Perbromo-phenol yields C_6Br_6 on heating with PBr_5.

E. WAHL finds that by the "*Action of* Br *on Hexan.*" The following bodies are obtained :—$C_6Br_6H_8$, $C_6Br_8H_6$, $C_6Br_8H_4$, C_6Br_8, C_6Br_6.

H. MAY prepares "*Carbo-diphenylimide*," by boiling HgO with sulpho-carbanilide in alcoholic solution.

J. HANIMANN, "*Reactions of Dimethyl-aniline.*" By heating the base with CCl_4 or $CHCl_3$ at high temperatures two strongly-characterised bases are formed, carbo-tetra-dimethyl-aniline, $C[C_6H_4.N(CH_3)_2]_4$, and formonyl-tri-dimethyl-aniline, $CH[C_6H_4.N(CH_3)_2]_3$.

A. BERNTHSEN has obtained "*An Isomeric Benzenyl-diphenyl-amidine*," $C_6H_5.C...(NC_6H_5)(NHC_6H_5)$, by the action of benzo-nitrile on diphenylamine.

A. BERNTHSEN, "*On the Thiamides of Monobasic Acids.*" The author describes two new reactions for the preparation of these bodies. The first is by the action of H_2S on amidines. Thus, benzenyl-iso-diphenyl-amidine yields benzo-diphenyl-thiamide,—

$$C_6H_5.C\begin{cases}NH\\N(C_6H_5)_2\end{cases}+H_2S=C_6H_5.C\begin{cases}S\\N(C_6H_5)_2\end{cases}+NH_3$$

Methenyl-diphenyl-amidine gives the formo-thianilide of Hofmann (CHEM. NEWS, vol. xxxv., p. 240) :—

$$H.C\begin{cases}NC_6H_5\\NHC_6H_5\end{cases}+H_2S-H.C\begin{cases}S\\NHC_6H_5\end{cases}+H_2NC_6H_5.$$

The second reaction is with CS_2 and amidines, thus benzenyl-phenyl-amidine yields benzo-thianilide—

$$C_6H_5.C\begin{matrix}N\\N\end{matrix}\Big\}H_2C_6H_5+CS_2=C_6H_5.C\begin{cases}S\\NHC_6H_5\end{cases}+CNSH$$

C. BÖTTINGER obtains by the "*Action of* H_2S *on Glyoxylic Acid*" several new bodies, the formulæ of which cannot be satisfactorily established.

E. WROBLEVSKY has obtained "*A New Xylidine*," (1 : 3 : 5), melting at 20°, and boiling at 220°, by reducing the nitro-xylol prepared from iso-xylol.

E. v. GERICHTEN, "*Cymene Derivatives.*" A chloro-cymene, $C_6H_3Cl.(CH_3)(C_3H_7)$, was prepared by the action of Cl on camphor-cymene, and this changed into α-chloro-toluic acid melting at 194°.

G. REHS obtains "*Phenanthrol*," $C_{14}H_{10}O$, in the form of blue fluorescent laminæ by melting phenanthren-sulphonic acid with KOH. Various ethers are described.

H. SALKOWSKI and C. RUDOLPH, "*Constitution of Dinitro-anisic Acid.* The acid was changed by heating with water at different temperatures successively into dinitro-paroxy-benzoic acid and sodium β-dinitro-phenyl-ate.

H. SALKOWSKI describes several "*Double Salts of Two Organic Acids*," obtained by bringing together equal quantities of benzoic and meta- or para-nitro-benzoic acids with the same base.

A. LADENBURG, "*Derivatives of Ortho-toluydin.*" The author obtains methenyl-ditolyl-diamin, by heating formo-toluide, and also by treating it with PCl_3.

A. BAEYER and H. CARO, "*Synthesis of Indol from Aniline Derivatives.*" Indol was found to be formed by passing through heated tubes the vapours of monethyl-aniline, diethyl-aniline, methyl-ethyl-aniline, acetyl-ethyl-aniline, dimethyl-ortho-toluydin, and diethyl-ortho-toluydin. The last yields the best results. Diethyl-para-toluydin forms no indol. The indol is separated in the form of the picrate from the reaction products.

Detection of Free Acids in the Gastric Juice.—M. C. Richet.—Pure gastric juice contains very little but mineral or analogous acids. If left to itself it ferments, and the proportion of organic acids, analogous to the lactic, increases.—*Comptes Rendus.*

NOTICES OF BOOKS.

The Sizing of Cotton Goods, and the Causes and Prevention of Mildew. By W. THOMSON, F.R.S.E. Manchester : Palmer and Howe. London : Simpkin and Marshall.

"The last and most important object of the majority of Lancashire manufacturers is to make grey cloths of specified dimensions, weight, and appearance with as little cotton as possible. The remainder of the weight, feel, and general appearance of the fabric to be made up with size." A rather startling confession this, and not easy to reconcile with a sentence which we find a few pages later that "sizing is a good thing, and may be carried on in a straightforward and honest manner, which is at present the case with the majority of Lancashire manufacturers."

The author disclaims any sympathy with adulteration, but thinks that size, beyond the proportion absolutely required to make the cloth withstand the wear and tear in the process of weaving, is valuable, because it "makes the fabric appear of better quality," and because the substitution of size for cotton "renders the resulting fabric much cheaper than would be that made entirely of pure cotton." The question, however, remains whether the degradation in quality is not out of all proportion greater than the reduction in price. We submit, further, that attempts to make any article of commerce look better than it really is are in their very essence cases of adulteration. The analogy drawn between calico and paper fails in several respects. We have no doubt that paper, like literature, may be at once pure and poor. It may also be sophisticated with substances which, though coming under the definition of vegetable pulp, are brittle and liable to clog the point of the pen. But calico is expected by the purchaser, whether he be an Englishman or a heathen Chinee to withstand a fair amount of wear and tear. With paper, now palimpsests are no longer manufactured, if it will bear writing upon once it has done its duty.

Leaving, however, the further consideration of these points to professed moralists, let us turn to the technological phase of the book before us. The author gives a full account of the machinery used in the process of sizing, illustrated with a figure of a modern power loom and of a tape-sizing machine. He next devotes a chapter to the apparatus and reagents employed in testing different ingredients used in size. Being ordinary laboratory-requisites they will be of course perfectly familiar to our readers. We are next introduced to the materials which the sizer throws into his cauldron. These the author divides into five classes. First come those required to give "adhesive properties" to the size, to wit, wheaten flour of different kinds, sago, maize, farina, rice, and dextrine or British gum. Next figure the materials used to give "weight and body" to the size and yarn, rendering the latter less like the baseless fabric of a vision. These are China clay, sulphates of baryta, lime, magnesia, and soda, soap-stone, silicate of soda, and chloride of barium. Among the oily or greasy matters used for softening the size and yarn are enumerated tallow of different kinds, palm oil, cocoa-nut oil, castor oil, olive and other oils, paraffin wax, and Japan wax. Then come a class of bodies which seem a repetition of the two former sections, since they also serve for softening and giving weight and body. Such are the chlorides of magnesium and calcium, glycerin, soap, and grape-sugar. Lastly, we find the remedies used to preserve the size from mildew and decomposition, namely, carbolic and cresylic acids, chloride of zinc and arsenical compounds. All these various bodies the author describes at considerable length, explaining their origin of manufacture, the methods of testing their quality, their advantages, drawbacks, &c. A great part of his remarks are of course to chemists "pipers' news," though to many manufacturers, merchants, and drapers they will doubtless be valuable. An interesting fact here mentioned is that Egyptian wheat-flour contains only 2·36 per cent of nitro

genous matter, or about one-fourth of the proportion here stated as found in English wheat-flour. Whether this great deficiency depends on the soil, the climate, the mode of cultivation, or the kind of the plant selected, does not appear.

Among the weighting ingredients figures sulphate of magnesia, in which, we are told, chloride of magnesium is an objectionable impurity. Yet, further on, we find the chloride of magnesium highly spoken of as strengthening the warp-threads to a greater extent than any other substance. It is, however, liable to produce mildew—the *bête noire* of the size-loving cotton manufacturer. What the author omits to mention is that chloride of magnesium, unless thoroughly washed out of textile goods before they are brought into use, is a direct attack on the health of the wearer by ensuring him the luxury of damp garments, bedding, &c.

The nature and origin of mildew is fully explained, and some of the cryptogamous plants to which it is traced are described and figured. As remedial, or rather preventive, agents arsenical salts are justly condemned, and the preference is evidently given to carbolic and cresylic acids.

The instructions given for the examination of a bale of cottons concerning which dispute has arisen, so as to ascertain whether the defects are due to the sizing or to negligence in packing, transport, and storage, are very judicious, and may be studied with advantage by experts who may be consulted on such questions.

Goods for shipment, the author holds, should be condemned if the inorganic constituents, and excess of moisture are large, the former above 13 and the latter above 1 per cent, and zinc chloride being absent or in very small proportion; if the goods contain chlorides of calcium or magnesium without a sufficient proportion of chloride of zinc or some other antiseptic; if the mineral ingredients are under 3 per cent and the farinaceous matters more than 15 per cent; with more than 0·5 per cent of excess of moisture and the absence of any powerful antiseptic. The normal moisture in cotton cloth is taken at 8 per cent.

We may think certain paragraphs of this work somewhat superfluous, and should in some instances prefer a different arrangement from that which the author has adopted. But we consider that he has thrown a valuable light on an important branch of manufacturing industry, and we trust that all concerned will remember and profit by his remark that the operation of sizing "as it now stands is one of the clumsiest, most unscientific, and least understood with which the manufacturer has to deal."

CORRESPONDENCE.

THE COLLEGE OF PHYSICAL SCIENCE.

To the Editor of the Chemical News.

SIR,—The letter communicated by Prof. Guthrie to the *Newcastle Daily Journal* of the 10th inst. regarding the College of Physical Science in Newcastle has now received a wider circulation and much increased publicity through the pages of your journal (vol. xxxvi., p. 32). As it is partly calculated to mislead your readers concerning some points of the efficiency and administration of the College, which are more or less directly touched upon in Professor Guthrie's emphatically-written letter, I trust that candour as regards the principal defects there noticed, and fairness as regards a tacit imputation of shirking their admission, which the publication of his letter (originally addressed to the managing body of the College) seems to convey, will ensure the insertion of a few lines in your journal in reply to such reproaches, and to remove any misapprehension that may have been produced of a necessity for their publication on that account having presented itself.

Prof. Guthrie's stirring remonstrance to the College authorities, although contained (as his letter shows) in a reply to a circular-invitation from them, and not appearing therefore to require a prompt acknowledgment, was yet considered with the deliberation and deference which it deserved, coming with the evidence of earnest good intention from such a high authority, and it was submitted to a committee already formed to devise improvements in the direction pointed out by Dr. Guthrie, and to report their recommendations to the College Council, by one of whom the thanks of the Committee were returned to Professor Guthrie for his communication. It was therefore without any assurance of their concurrence and consent that the unexpected reproductions of Professor Guthrie's letter in the columns of a Newcastle daily newspaper and in the pages of the CHEMICAL NEWS have since then appeared.

As regards the defects and deficiencies which are so strongly apostrophised in the letter, I need not occupy your space by referring to them further than to add that where Professor Guthrie's statements, which are in the main correct about the apartments which he visited, are not quite accurate in some details, allowance must be made for the short time that he had to make himself acquainted with the uses and capabilities of the parts of the College which were shown to him, more complete introduction to which, if the brief opportunity of his stay here had permitted, would perhaps have enabled him to modify somewhat the opinions which he expressed, and to take a less despairing view than he seems to have done of the aspects of physical science in the College of Science in Newcastle.—I am, &c.,

A. S. HERSCHEL.

College of Physical Science,
Newcastle-on-Tyne, July 23, 1877.

COMMERCIAL SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—Can you inform me where commercial sulphuric acid, approximately free from arsenic, can be obtained? The firm from whom we have till now obtained our chemicals say that the only sulphuric acid free from arsenic which they can now supply is at the rate of a shilling per pound.

Is there any reason why sulphuric acid made from sulphur should not now be obtained just as easily as formerly? It is inconvenient (not to say dangerous) to allow boys to make hydrogen from sulphuric acid containing so much arsenic that the gas burns with a brilliant white flame, and it is not economical to have to purchase sulphuric acid for such purposes at the price of a shilling per pound.—I am, &c.,

W. MARSHALL WATTS.

Giggleswick Grammar School,
Near Settle, Yorkshire.

ON THE DETERMINATION OF THE ORGANIC MATTER IN POTABLE WATERS.

To the Editor of the Chemical News.

SIR,—The late Dr. Matthiessen is credited with the remark that the ammonia-process of water-analysis had one fault, and one fault only, viz., that it was invented by Wanklyn, Chapman, and Smith. The paper of Professor Dittmar which you have just published (CHEM. NEWS, vol. xxxvi., p. 26) tempts me to add that there was a much more serious fault in the process, viz., that it was brought out before its time, and that the difficulties which its inventors encountered and sought to surmount were difficulties which had not risen above the horizon which bounded the mental vision of their contemporaries.

In making this remark I mean nothing disrespectful to Prof. Dittmar, but the reverse, since, observing that he is

absolutely unconscious of that which ten years ago appeared to us to be self-evident, I do not accuse him of any stupidity, but say that his want of discernment is the fault not of himself, but of the times in which he lives.

The passage in Prof. Dittmar's paper to which I take especial exception is this:—"While Mr. Wanklyn himself, on the other hand, would surely be the last to deny that his method, in its present form, is far from being so absolutely constant in its results as not to be at all the better for being supplemented by a determination of the organic carbon and total organic nitrogen."

To this Mr. Wanklyn replies that (as is well known) he holds that Frankland's organic carbon and organic nitrogen are, for the most part, unreal quantities, but he goes very much further than that, and maintains that if they were real,—that is to say, if the numbers in a Frankland water-analysis were the numbers expressing the real quantities of organic carbon and nitrogen in the water-residues which have been submitted to the ceremony of combustion,—even then they would be irrelevant to the question, and would afford no assistance to the analyst with the ammonia-process within his reach.

Ten years ago, when the ammonia-process came out, its authors were under the strong influence of this conviction, and to that influence chemists are indebted for the initiation of the process which has been so widely accepted.

My colleagues and I have induced contemporary chemists to adopt our process, but I look upon the task of bringing them to a comprehension of the merits of the process as much more difficult, and in putting forward the following considerations I have not much hope of being successful:—

When a chemist examines a sample of water, what he really wants to know is what the water contains; and what may happen to be in the water-residue can only be of interest to him in so far as it is a guide to what there was in the water that left the residue. In the case of the imperishable mineral constituents that are dissolved by the water, there is nothing illogical in resorting to the water-residue; but it is a stupendous absurdity, and to my mind it appears an incomprehensible act of folly, for the chemist to search the water-residue for the perishable organic *débris* which originally existed in the water.

The ammonia-process was our protest against that supreme act of folly. The organic matter in the water we attacked in presence of the water, and by so doing we gave a true solution of the problem in place of the sham solution which Dr. Frankland would have passed off if he had overcome the mechanical difficulties lying in his path.—I am, &c.,

J. ALFRED WANKLYN.

Laboratory, 117, Charlotte Street, Fitzroy Square, London, W., July 23, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 26, June 25, 1877.

Heat Disengaged by Chemical Combinations in the Gaseous State: Anhydrous Acids and Water.—M. Berthelot.—In this paper the author examines the combination of water with anhydrous nitric and acetic acids and with anhydrous chloral.

Equivalent of Organic Compounds.—M. Berthelot.—The author maintains that in organic as in mineral chemistry, the equivalent of water, HO = 9; that of hydrogen, H = 1; and that of acetic acid, $C_4H_4O_4 = 60$ represent three correlative weights.

New Anthophyllite from Bamle, in Norway.—M. Des Cloizeaux.—Anthophyllite, essentially consisting of silica, ferrous oxide, and magnesia, and very near in its chemical constitution to the group of the amphiboles, from which, however, it is distinctly divided by the rhomboid type of its crystals, offers new analogies with some of the members of this important group. Like to them it may contain a large proportion of alumina, and it possesses a marked tendency to form pseudomorphs.

Phosphate of Lime Glass.—M. Sidot.—The acid phosphate of lime is transformed by heat into an entirely crystalline body. This substance, which the author calls pyrophosphate of lime, if exposed afresh to a higher temperature, becomes perfectly vitreous, giving up a part of its elements, and descending probably to the state of tribasic phosphate of lime, $3CaO,PO_5$. The glass thus obtained is perfectly transparent; its index of refraction is 1·523, that of crown glass being 1·525. Its specific gravity is 2·6. It is not attacked by acids in the cold, but it is acted on by boiling acids and potassa. It is not affected by hydrofluoric acid.

Dissociation of Carbides by means of a Palladium Wire, and on the Connection of the Facts with Catalytic Phenomena.—M. J. Coquillion.—If the protocarbide or bicarbide of hydrogen is passed over a spiral of palladium at a dull red-heat the gaseous volume is not sensibly affected, but if it is raised to a white redness, after cooling a considerable augmentation of volume is observed, and on the cooler part of the wire is found a pulverulent deposit of carbon, resulting from the dissociation of the carbides. The hydrogen is set at liberty. With platinum wire a decided increase of volume has not been obtained.

Determination of Potassa.—M. A. Carnot.—Reserved for insertion in full.

Nickeliferous Iron of Santa Catarina, in Brazil.—M. Guignet.—This deposit, which was probably a meteorite, is exhausted.

Description of Several Minerals.—F. Pisani.—The species described are the triphane of Brazil, the anthophyllite of Bamle, the tephroite of Langban, in Sweden, and the pharmacosiderite of the mine of La Garonne (Var).

Les Mondes, Revue Hebdomadaire des Sciences, No. 7, June 14, 1877.

This issue contains no original chemical matter.

No. 9, June 28, 1877.

The Swiss Society of Natural Sciences will meet this year at Bex, in the canton of Vaud, from the 19th to the 27th of August, under the presidency of M. Louis Dufour, of Lausanne.

M. Tremeschini, of Paris, has constructed a sensitive metallic thermometer on a new principle. The expansions of a small leaf of platinised silver are augmented by means of a system of levers, and the movement is communicated to the needle of a graduated scale. The action of the needle is instantaneous.

MM. Deprez and Napoli have constructed a new instrument for ascertaining the relative value of lubricating oils. The apparatus consists essentially of two plates, one of which is movable and may take different known speeds, whilst the other, also movable, is pressed against the former by weights arranged previously, and retained in its place by a ribbon of steel attached to a dynamometer. Each experiment lasts some hours.

At Neubourg (Eure) is a well the waters of which are charged with oxygen; 4 litres hold 83 c.m. of air in solution, of which 44·6 per cent (by measure) is oxygen and 55·4 nitrogen. The water is found to whiten linen very well, and does not attack the hands. The amount of mineral matter is 0·9688 grm. per 4 litres.

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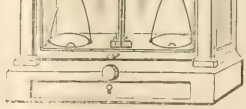

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THE CHEMICAL NEWS.

Vol. XXXVI. No. 923.

ON REPULSION RESULTING FROM RADIATION.—PART IV.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 36.)

191. To obtain the nearest approach to the theoretical curve of intensity from my results, it will not be right to take the mean of all my observations. The error can only be on one side—that of deficiency. Therefore the lower observations must be rejected, and the highest results only taken.

Bearing in mind that the spectrum formed with glass prisms is condensed at the red end and expanded at the blue end, it would appear from an inspection of the curves, that, with a normal spectrum, such as a diffraction-grating would give, the maximum of action should be at a little below A in the ultra-red, and that the curve should descend equally on each side.

192. This appears to be the most appropriate place to discuss the question which, from its being almost invariably asked the first, seems to be of the greatest interest to most inquirers:—"Is the effect due to *heat* or to *light*?"

I cannot answer this question. The terms heat and light are not definite enough. The physicist has no test for light independent of heat. Light and colour are physiological accidents, due to the fact that a small portion near the middle of the spectrum happens to be capable of affecting the retina of the human eye. There is no real distinction between heat and light; all we can take account of is difference of wave-length; and all we can see in the spectrum is one continuous series of vibrations, longer at the red end than at the violet end, but extending in an unbroken series for an unknown distance on each side. I say unknown, for it is probable that the whole spectrum, as we know it, is limited by the imperfect transparency of the atmosphere, or of the refracting medium, for the extreme ultra-red and ultra-violet rays.

Take a ray of the spectrum of a definite wave-length (the line B for instance), and allow it to fall on a thermometer; the mercury rises, showing the action of *heat*; concentrate it on the hand by a lens, it raises a blister accompanied with pain; let it fall on a bismuth and antimony couple, the galvanometer is deflected; and this action we also call one of *heat*. Let the ray fall on the eye, and it produces the sensation of *light* and *colour*. Let it fall on a collodion plate prepared in a particular manner, and it gives a permanent image, showing that it can cause *chemical action*. Lastly, throw the ray on a portion of matter free to move in a vacuum, and it makes itself evident as *motion*. Now these actions of *heat*, *light*, *colour*, *chemical action*, and *motion* are inseparable attributes of the ray of that particular wave-length; and to consider that there can be a splitting-up of this ray into two or more rays of the same refrangibility, one having the property of light, the other of heat, &c., is to my mind an absurdity.

The longer waves of the spectrum are those most able to produce heating-effects, the shorter waves best cause chemical action, and the intermediate waves easiest excite the sensation of vision; but although the maxima of these actions are at different parts of the spectrum, each effect can be detected at any part.

In a similar way the production of motion has its maximum in the waves situated at the ultra-red part of the spectrum, whilst it is capable of being rendered evident in all parts. This at first sight would favour the supposition that the action was due to the heating power of the waves.

193. How far this is really the case may be seen by the following Table, in which I have reduced the maximum to 100, and given the motion-producing value of the different colours of the spectrum, reduced in the same proportion:—

Ultra-red	100
Extreme red	85
Red	73
Orange	66
Yellow	57
Green	41
Blue	22
Indigo	8½
Violet	6
Ultra-violet	5

A comparison of these figures with those usually given in text-books to represent the distribution of heat in the spectrum will be a sufficient proof that the mechanical action of radiation is as much a function of the luminous rays as it is of the dark heat-rays.

194. In the intervals of spectrum work I tried many other experiments with the apparatus. I was anxious to get the exact time of the oscillations of the beam in a vacuum, and tried many ways of starting the initial impulse.

A candle held close to the screen, and the shutter momentarily opened and closed, sent the index with some violence to the extreme limit of the scale. It then slowly came back to zero and there stopped. Magnesium wire used in the same way produced the same effect. There was no oscillation, as there would have been if the impulse had been given by a material blow. The movement of the beam, as shown by the spot of light, seemed as if it were held in check by a force acting the whole time of its movement, and not only for the time the light acted. The impression conveyed was that the beam was swinging in a viscous fluid, and the more perfect the vacuum the greater appeared to be the viscosity (107). Thinking that the heat-rays from the candle might be absorbed by the black pith and so raise its temperature, I interposed screens of water, alum, and thick plates of glass, so as to cut off the ultra-red rays. Still the apparent resistance to free oscillation continued.

I then, without interfering with the vacuum, and without letting radiation fall on the pith surface, gave the apparatus a sudden twist round, so as to cause the beam to knock against the side of the tube. This set it swinging through a large arc, and the oscillations kept up with perfect freedom for several minutes, declining in amplitude at each oscillation till the beam ultimately came to zero. This perfectly free movement is in strong contrast to the constraint under which the beam moves when the initial blow is given by a ray of light instead of by a mechanical push.

The same effect was noticed during the experiments with the spectrum. A ray in the blue, falling on the pith, would drive the index twenty divisions along the scale. It would then gently come back to zero, where it would stop, occupying the same time to come back as it did to go forward. If, however, after the action of the light had entirely ceased, I gave the tube a slight jerk, so as to cause the beam to swing through the same arc, the index on returning to zero would pass perhaps 15 degrees the other side, and would thus oscillate for some time from one side to the other of zero, taking many minutes to come to rest.

195. This phenomenon enables me to advance a step towards an explanation of the mechanical action of radiation, although I fear I shall have to make some assumptions which are scarcely yet proved.

* A Paper communicated to the Royal Society, February 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

A ray of light falls on a white surface and is reflected back again; it does no work there (170, 171); but if the ray falls on a black surface it is absorbed and quenched. What becomes of it? It seems to me probable that the ray becomes converted into thermometric heat, and that its energy is in whole or in great part used up in raising the temperature of the dark body. But having thus become warm, the powerful radiating action of the surface for heat comes into play, and the heat, which has just been engendered and absorbed, is quickly radiated back again. It would appear as if this radiation of heat from the surface of a body caused the latter to retreat backwards, and so produced the motion. This would account for the apparent viscosity of the vacuum; for the heat radiating from the black surface of the pith would act in opposition to the torsion, and hold the latter force in check till it was itself all dissipated. The superiority of pith over metal is also accounted for. Pith is one of the worst conductors of heat, and thus allows all the heat to radiate from the same surface which absorbed it; whilst metals, being the best conductors of heat, allow it to pass through and radiate almost as much from one surface as the other.

The slight action of the blue rays is thus due to their short vibrations not being capable of transmutation into so much thermometric heat as are the longer rays; whilst the strong action of the red rays is owing to the degradation necessary to convert them into heat being but slight.

This action is parallel to that of the production of phosphorescence. A ray of such high refrangibility as to be invisible falls on a suitable surface; it is there absorbed, degraded in refrangibility, and radiated out again in the form of visible rays of longer wave-length. We have only to imagine our eyes to be unaffected by what we now call light, but capable of responding to an octave lower in the spectrum, and we should see the same thing when the blue ray falls on the blackened pith. In such a case an invisible beam would be thrown on a suitable surface of lampblack; the latter would instantly respond, lowering the refrangibility and increasing the wave-length to the point of visibility; the ray so generated would be absorbed and then radiated back again, the lampblacked surface glowing with light for some time after the original ray had ceased to fall on it.

196. Making use of the property discovered by Dr. Tyndall of the almost perfect transparency for the invisible heat-rays of iodine dissolved in disulphide of carbon, and its opacity to the luminous rays, experiments were instituted with a view to obtain a numerical comparison of the mechanical action which was due to the invisible rays and that due to the visible rays.

The apparatus was used as fitted up for spectrum observations (187), the prisms and lenses being removed. A ray of sunlight was reflected from the heliostat, then reflected by means of a right-angled prism (placed in the usual position of the refracting prisms) into the apparatus.

The action of the sunlight was far too powerful for the apparatus, and I accordingly passed it through a plate of alum, a thick piece of glass, and an empty glass cell.

On opening the shutter the pith was powerfully repelled, the index ray moving 300 divisions. The cell was filled with disulphide of carbon, and the experiment again tried. The index moved to the same point.

The clear disulphide of carbon was removed, and it was replaced by a strong solution of iodine in disulphide of carbon. This was opaque to the sun's ray. On opening the shutter the deflection amounted to 79°.

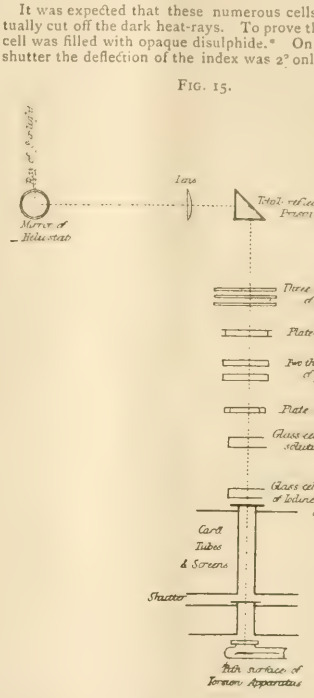
This experiment shows that the total radiation from the sun, passing through alum and glass screens, produced a deflection of 300, whilst if the whole of the light was cut off by interposing a solution of iodine in disulphide of carbon, there was still a movement of 79. This 79 was the effect due to dark heat which penetrated the alum, the difference (221°) being due to light.

I endeavoured to cut off the whole of the dark heat, so as to work with the luminous portion only of the solar radiation. The ray of sunlight reflected from the heliostat was accordingly passed through the following screens, placed one behind the other, as shown in fig. 15:—

A lens.
A thick, total-reflection, right-angled prism.
Three thin plates of glass.
A plate of alum 7½ millims. thick.
Two thick glass plates.
Another plate of alum, 5 millims. thick.
A glass cell full of saturated solution of alum.
An empty glass cell.

It was expected that these numerous cells would effectually cut off the dark heat-rays. To prove this the empty cell was filled with opaque disulphide.* On opening the shutter the deflection of the index was 2° only.

FIG. 15.



What came through the alum, glass, and water screens was therefore pure light, practically free from the dark rays which are called heat.

The opaque disulphide was then replaced by clear disulphide. The deflection was 105°.

	Action of filtered sunlight.
Opaque disulphide	2 degrees.
Clear disulphide	105 ,,

Deducting the 2° as representing the trace of dark heat which escaped the alum, glass, and water screens, the difference (103°) represents the action of the luminous portion of solar radiation and of that small quantity of the ultra-violet rays which would pass the screens; for had the effect of the sun's radiation after passing through the screens been due to *heat*, on cutting off the *light* by means

* For the sake of brevity I call the solution of iodine in disulphid of carbon *opaque disulphide*, the disulphide of carbon alone I ca *clear disulphide*.

of opaque disulphide, the deflection should have been practically undiminished. But experiment shows that, after passing through the screens, the repulsion due to heat is less than 2 per cent of the total action of the solar ray.

The screens, whilst diminishing the heat almost to nothing, also cut off a considerable quantity of the light.

197. A similar series of experiments was tried with the radiation from a candle. No alum, glass, or water-screens were at first interposed, and the deflections were taken with the clear and opaque disulphide, alternately put in the path of the ray. The candle was 3 feet off. The mean of several experiments were as follows :—

Opaque disulphide	28 degrees.
Clear disulphide	130 ,,

This shows that much of the action of a candle is due to rays which pass through iodine, *i.e.*, to the ultra-red rays.

The candle was now brought 2 feet from the apparatus, and the alum and glass screens were interposed. On repeating the experiments the mean result was as follows :—

Opaque disulphide	5 degrees.
Clear disulphide	37 ,,

(To be continued.)

REPORT

ON THE METHODS EMPLOYED IN THE

ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,

AND ON THE

MODE OF STATING THE RESULTS.*

(Concluded from p 39.)

II. Statement of the Results of Analyses of Potash Salts.

Your Committee has devoted considerable attention to the difficult question of the proper mode of stating the results of analyses of potash salts. Hitherto the statements of various analysts appear to have been characterised by a lamentable want of system, and in many cases they are greatly at variance with the generally accepted principles of chemical combination and double decomposition.

The Committee has been furnished with copies of analyses of potash salts in which carbonate of potassium is reported as co-existent with sulphate and chloride of sodium, and the cases are numerous in which similar anomalous statements occur.

These various modes of statement are by no means solely due to eccentric notions respecting chemical affinity, but appear in many cases to be owing to the desire to attribute as high or low, (as the case may be), a commercial value to the article analysed, as is compatible with its percentage composition. Thus, a commercial carbonate is chiefly valuable on account of the potassium carbonate it contains, and therefore if the whole of the potassium be stated as existent in that form, while the valueless sulphate and chloride are relegated to the sodium, the *apparent* value is considerably greater than if only that portion of the potassium be assumed to exist as carbonate which is in excess of the quantity necessary to combine with the more powerful salt radicals.

The Committee believes it would be practically impossible to lay down general rules for statement of results which, if followed, would necessarily and invariably lead to an exact and scientific statement of the mode of existence of the various metals and salt radicals in a complex commercial salt of potash, but it is of opinion that, whatever modifications in detail individual analysts may think proper to adopt, the following general principles should be adhered to :—

1. The plan should be adopted of combining the strongest metal with the strongest salt-radical, after due allowance for the tendency to form insoluble or nearly insoluble salts. Thus the soluble calcium should always be stated as existent as sulphate. The excess of the salt-radical should be combined with potassium on the ground that chloride, nitrate, or carbonate of potassium is incapable of co-existence with sodium sulphate.

In the case of artificial or acid sulphates produced by treating "muriates" with vitriol the Committee is of opinion that the free acid is sulphuric acid, not hydrochloric acid. The reason for this opinion is to be found in the fact that any free hydrochloric acid would inevitably have been volatilised at the temperature employed in the production of the sulphate. The same remark applies to sulphuric acid if actually free, but, if in combination with sulphate of potassium to form an acid salt, it might resist decomposition. The acid salt here mentioned as a compound of sulphuric acid and sulphate of potassium would be more correctly described as potassium hydrogen sulphate, $KHSO_4$, but your Committee believes that the practical inconvenience of stating a certain amount of potassium in this form and the rest as neutral sulphate would outweigh any advantage to be derived from a scientifically exact statement.

It is evident that the presence of free sulphuric acid or of an acid sulphate in artificial sulphates can only be due to imperfect admixture of the vitriol and muriate, otherwise the following well-known reactions would have taken place :—

$$K\,HSO_4 + KCl = K_2\,SO_4 + HCl \quad \text{and}$$
$$NaHSO_4 + NaCl = Na_2SO_4 + HCl.$$

In the event of the bulk of the muriate consisting of chloride of potassium it may be argued that there is a greater probability of that salt remaining unacted on than that chloride of sodium should remain undecomposed, but it is evident that the circumstances are such as must vary with the conditions of each case, and your Committee therefore prefers to recommend the adoption of the arbitrary assumption that all potassium exists as sulphate, provided that there is sufficient of that salt-radical present to combine with the whole of the potassium after allowing for the free acid and the sulphate of calcium.

On the other hand it may be argued that as sulphates are always converted into carbonate or caustic alkali, any chloride present in the sample would ultimately be lost in the worthless form of chloride of potassium, whatever the metal with which it was originally combined. This argument has considerable force, and to meet it the Committee recommends that all statements of the results of the analyses of artificial sulphates should have appended the equivalent in chloride of potassium of the chloride found. In artificial sulphates there is considerable probability that the chlorine exists chiefly, if not wholly, as chloride of potassium, but such cannot be assumed to be the case with other sulphates, and in the statement of the composition of those the Committee considers the above calculation undesirable from a scientific point of view, though it is clear that there are other considerations in its favour.

The distribution of the salt-radicals among the remaining metals (sodium, magnesium, and iron) appears to the Committee to be a matter of indifference, as the precise arrangement will not affect the value of the sample nor cause any alteration in the sum of the constituents, while there appears to be no reliable evidence of the actual mode of combination.

In the case of "muriates" and sulphates having an

* Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

alkaline reaction, such as those made from kelp and beet-root, potassium and sodium are the only two metals present in more than traces. In the statement of all such analyses your Committee is of opinion that the only proper method is to calculate the potassium as sulphate, chloride, and carbonate in succession, and assuming no sodium to exist as sulphate or chloride unless the amount of potassium present is insufficient to satisfy the latter or both of those salt-radicals.

The impossibility of the co-existence of sodium sulphate or chloride with potassium carbonate is proved by the fact that double decomposition occurs when solutions of these salts are mixed and concentrated. The non-deliquescent character of kelp sulphates and muriates also furnishes a strong independent proof of the absence of potassium carbonate.

The same principles apply to the statement of the results of the analyses of commercial carbonates of potassium, and in their case its adoption becomes still more important.

In the case of nitres only that portion of the potassium can be properly considered to exist as nitrate which is in excess of the quantity required for calculation as potassium sulphate (after allowing for the sulphate present as calcium sulphate). Whether some of the potassium will also exist as chloride, or whether there will be some sodium nitrate present, must depend on the respective amounts of potassium and NO_3 found; but having regard to the well-known reaction $KCl + NaNO_3 = NaCl + KNO_3$, your Committee is of opinion that presence of both chloride of potassium and nitrate of sodium in the same sample is improbable.

In brief, the Committee is of opinion that in calculating the results of analyses of potash salts, the following method should be adhered to in combining the various metals and salt-radicals present in the portion of the sample soluble in water.

Basic hydrogen, which is met with only in artificial sulphates, exists as sulphuric acid, or more strictly speaking as potassium hydrogen sulphate, $KHSO_4$.

Calcium does not occur in practice in excess of an equivalent amount of sulphate, so that it should always be calculated to $CaSO_4$. The remaining constituents of the soluble portion of the sample should be arranged on the principle of combining the strongest metals with the strongest salt-radicals.

The order of affinity which the Committee considers most in accordance with observed facts and theoretical propriety is shown in the following list, in which the strongest metals and salt radicals are placed first.

Potassium	Sulphate
Sodium	Nitrate
Magnesium	Chloride
Iron	Carbonate.

The Committee is of opinion that in all cases in which one of the constituents of a sample is determined by subtracting the sum of the others from 100·00, the fact ought to be indicated in the statement of results. This can readily be done by appending the words "by difference" or "estimated by difference" to the name of the constituent thus determined. The adoption of this plan would obviate many of the disadvantages attendant on indirect determinations, but the Committee strongly recommends the employment of direct processes whenever possible.

In all cases where such a course is possible it is very desirable that the various compounds of potassium present should be calculated into the salt which the name of the article indicates as the leading constituent of the sample. In the case of sulphates, muriates, and carbonates, the corresponding amount of anhydrous potash should be stated. Thus the Committee recommends that an analysis of a German muriate should be stated somewhat in the following manner:—

Per Cent.	Potassium Chloride.	Anhydrous Potash.
Calcium sulphate ..	—	—
Potassium sulphate A	*a*	*x*
Potassium chloride B	B	*y*
Sodium chloride ..	—	—
Magnesium chloride..	—	—
Insoluble matter ..	—	—
Water	—	—
	100·00	$B+a$	$x+y$

In the case of carbonates, the anhydrous potash corresponding to the carbonate of potassium present, should always be stated separately from that calculated from the sulphate and chloride, as it is only in certain cases that the potassium existing in the latter forms is of any value.

ERRATA.—On page 38, col. 2, line 32 from bottom, *for* "when heavy metals" *read* "when *no* heavy metals." Page 39, col. 1, line 19 from top, *for* "was found to exceed" *read* "was *not* found to exceed."

ON THE SOLUBILITY OF THE ALKALIES IN ETHER.*

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

IT has hitherto been supposed by chemists that the alkalies are insoluble in ether, but having been led to doubt the truth of this supposition, from observing certain facts which lately came under my notice, I at once set to work to investigate the matter, and, as it is one of some importance in connection with toxicological examinations, I think it proper to submit the results of this to you.

My experiments for this purpose were performed both with hydrous and anhydrous ether.

Taking first the hydrous ether—that is the commercial article, and that which we really have to deal with in the kind of examinations above alluded to—I agitated separate portions of it with an aqueous solution of caustic potash and carbonate of soda (common soda), then decanted the ether off into clean test-tubes, and again from these tubes into platina vessels. I then allowed the liquids to evaporate, when I found the residues resulting from this had a very alkaline reaction, and which was persistent when they were gently ignited and dissolved in water, clearly showing that a fixed alkali was present in both cases in a free state, or at least as a carbonate. Both magnesia and lime also dissolve in this kind of ether to a notable extent. Bicarbonate of soda, however, hardly appears to do, or, if so, only in minute quantities.

In regard now to the solvent power of ether itself—that is, the anhydrous substance—I find that, when this is mixed with dry potassic hydrate, allowed to clear, and then decanted off, a marked alkaline reaction is also obtained by dipping reddened litmus-paper into it, and which is more intense than can be occasioned by any minute trace of alkaline acetate possibly present in the ether, resulting from an inter-reaction of the potash upon it.

The alkalies and their inferior carbonates, therefore, not being insoluble in ether, and alkaloidal carbonates being, as I find, freely soluble therein, I would recommend in special cases, for isolating and obtaining pure alkaloids by Stas's process, the use of bicarbonate of soda, or, better still, an earthy carbonate, in place of caustic alkali, as now employed in aid of this.

I may perhaps be permitted to state further, in reference to the solvent property of anhydrous ether, that I find many salts are soluble to a notable extent in it which are insoluble, or nearly so, in that which is hydrous; for instance, the chlorides of calcium, nickel, zinc, cadmium,

* Read before the Wellington Philosophical Society, January 29, 1876.

and platinum,—also the sulphocyanides of nickel, copper, and zinc. The addition of a small quantity of water to any of these ethereal solutions generally renders them very turbid, as the salt they contain is thereby precipitated as a hydrate. By the use of anhydrous ether, and by conducting the necessary evaporations in dried air, it is in fact possible to form many saline compounds hardly—if at all—producible otherwise. In this way I have prepared double sulphocyanides of nickel, and even of copper, with certain alkaloids, using chloride of calcium to dehydrate the saline solutions requisite for this.

ON

SOME SIMPLE LABORATORY MANIPULATIONS.

By Dr. P. TOWNSEND AUSTEN.

I.

THERE are many little operations performed in the Laboratory which, although they are not of great importance, are still often of convenience to the working chemist. Sometimes a simplification or improvement of these little processes may save much labour and annoyance.

Use of Felt Pads in Protecting Glass Vessels.

The destruction of glass vessels is dependent on many causes. The vessel may stand on grains of sand which scratch the glass. If the glass is not well tempered it may sometimes, on being slightly scratched by these grains of sand, suddenly go to pieces, somewhat in the manner of a Prince Rupert's drop. If stone surfaces are used on the Laboratory tables, accidents occur continually. Vessels, if not placed very carefully on the slabs, may be struck against them. Or if a glass vessel containing a hot liquid be placed on a cold stone surface, the glass around the bottom is quite certain to crack.

After trying various means of prevention, I found that pads of felt were by far the best mediums for protecting glass vessels.

Felt, about half an inch in thickness, such as is used in restaurants for placing under beer-glasses, or for roofing purposes, can be bought at a very moderate price. It should be cut up into squares, or, better, into oblong pieces ranging from 2×4 inches to 8×12 inches. A beaker filled with a hot liquid—boiling sulphuric acid, for instance—may be placed with perfect safety on one of these pads. The felt is a very poor conductor of heat, and the glass hence preserves its temper admirably. Neither is there enough resistance offered to the glass surface to allow it to be scratched by any grains of sand which may perchance be on the felt. By striking the pads against the table all sand and grit may easily be removed from them.

The softness of the felt removes all chance of breakage, and it is really remarkable how long a set of beakers will last when always allowed to cool off on felt pads.

If the pads get wet a day in the air-bath will restore them.

I make it a rule, in my work, to have a pad under every piece of glass apparatus on my Laboratory table. If felt cannot be obtained, pads of thick carpet may be used with good effect.

The Examination of Crystals by the Microscope.

In chemical research the microscope plays an important part in revealing the presence of crystalline substances in solutions. The usual method of preparing substances for examination by the microscope when, as in the Laboratory, fine microscopes, animalculæ, cages, and other conveniences are not at hand, is to evaporate some of the solution on a watch-glass over a micro-chemical gas-flame, and then rub with a glass rod, when the crystals begin to grow on the minute scratches in the glass, and thus set up a general crystallisation. The crystals formed in this manner, however, are rarely satisfactory, being often broken, misformed, or mixed with a large amount o the substance in a partially amorphous state.

If the solution be evaporated to the right consistency in a watch-glass, and another watch-glass of the same size, previously warmed, be placed upon it, the drop expands to a film. The upper glass should not be pressed, but allowed to rest of itself. The film is similar to the one obtained in an animalculæ cage, being, however, thicker. If now a few drops of ether be placed in the upper watch-glass, the cold caused by the evaporation of the ether will cause a crystallisation to take place between the watch-glasses. The growth of the crystals can be quite accurately managed by increasing or diminishing the cold on the surface (by blowing on the ether).

The crystals formed are, as a rule, perfect in shape. I have by these means obtained well-defined crystals from solutions which, by rubbing with glass rods, afforded me only amorphous powders.

New York School of Mines,
April 1, 1877.

ON THE

CONTROLLING OF THE ESCAPES OF SULPHUR GASES IN THE MANUFACTURE OF SULPHURIC ACID.*

By JAMES MACTEAR.

THE escape of sulphur gases into the atmosphere from the combustion of coal, and the manufacture of sulphuric acid, has recently assumed great importance from the interest attached to the investigations of the "Noxious Vapours Commission."

In the case of coal the escape is quite beyond our control, except in so far as the economy of fuel is involved in the question, but the case is different in the manufacture of sulphuric acid, where it should be reduced to lowest possible point.

Most sulphuric acid makers place great reliance on their yields of oil of vitriol (or of sulphate of soda) as a measure of the efficiency of their management; and so it would be were it not for the difficulty of obtaining accurate figures. But the question is so involved in doubt as to the correctness of stocks and consumption of raw materials and produce, the accuracy of measurements, temperatures, specific gravities, and calculations, that the question of "production" may be discussed *ad nauseam* without advancing one step beyond the point of personal belief.

This being so, I decided many years ago to adopt as a general principle, that it would be much more satisfactory to know what was lost rather than approximately what was obtained; and it is on the application and results of this principle that I purpose treating in this paper.

It has been customary with many manufacturers to make occasional tests of the residual gases escaping from their vitriol chambers: but I believe I have been the first to introduce continuous testing in terms of actual loss.

I began the investigation connected with this subject so far back as 1866, but it was only in 1874 that the present system was finally worked out and in operation.

The apparatus consists of a Bunsen pump for aspirating the gases, an absorbing apparatus suited to the requirements of the operation, and a meter to measure the volume of the residual gases after absorption.†

The application of this arrangement to the vitriol chamber escapes is very simple. The apparatus is connected with the outlet of the Gay-Lussac towers or chambers; and set in operation, we thus obtain results

* Read before the Newcastle-upon-Tyne Chemical Society March 22, 1877.

† This apparatus is equally applicable to continuous testing of other gases, and a modification of it has recently been applied with great success in the examination of the air of large towns by Mr. E. M. Dixon and Dr. Russell.

showing the sulphur gases escaping per cube foot. We now require to know what relation this figure bears to the actual loss of sulphur, and the following calculation will illustrate the matter. It has as yet been found extremely difficult to estimate the cubic feet of residual gases passing in the outlets with accuracy by any form of anemometer, and I have relied on the oxygen determination, which should form a regular part of the testing in a vitriol manufacturer's laboratory, to enable him to calculate the residual gases passing.

To illustrate the subject let us assume that we are employing pure FeS_2 and perfect combustion taking place; let us also take the following data for calculation :—

	Atomic Weight.
Hydrogen	1·00
Nitrogen	14·02
Oxygen	15·96

Taking the crith as 0·0896 grm., 1 litre will weigh at the standard temperature, of 0° cent, and 760 m.m. Bar.; of—

	Grammes.
Hydrogen	0·0896
Nitrogen	1·2560
Oxygen	1·4300
Air	1·2930

And a cubic foot being equal to 28·316 litres, the weight will be of—

	Grammes.	Lb.
Hydrogen.. ..	2·5371136	0·00559337
Nitrogen	35·5648960	0·07840731
Oxygen	40·4918800	0·08926931
Air	36·6125880	0·08071687

The composition of air being taken as—

	By Weight.	By Volume.
Oxygen..	23 parts.	20·8 parts.
Nitrogen	77 ,,	79·2 ,,
	100 parts.	100·0 parts.

Let the basis of calculation then be one ton of pure FeS_2 and we have the decomposition—

$$2FeS_2 + 15O = Fe_2O_3 + 4SO_3;$$

Or gravimetrically, 120 FeS_2 requires 120O.

∴ 20 cwts. of FeS_2 will require 20 cwts. of oxygen;

and as air contains 23 parts by weight of oxygen, 20 cwts. of oxygen will equal 87 cwts. of air containing 67 cwts. of nitrogen—this nitrogen being equal to a bulk of 95,705·3 cubic feet.

Assume, then, that in an apparatus burning pure FeS_2 with perfect combustion, there is found in the escaping gases, after complete decomposition and condensation, oxygen equal to 10·00 per cent by volume, it is evident that if we take the air as containing 20·00 per cent of oxygen, the total volume of the escaping gases will be double the volume of the nitrogen; or,—

	Cubic Feet.
Nitrogen	95,705·3
Air at 20·00 per cent O ..	95,705·3
	191,410·6

Volume of gases escaping, containing 10·00 per cent of oxygen.

Correcting this for standard temperature of 15·555° C. and Bar. 760 m.m., we get—

	Cubic Feet.
Nitrogen	101,158·4
Air at 20·00 per cent O..	101,158·4
	202,316·8

Cubic feet escaping.

The true percentage of oxygen in the air being 20·80, he correction will be $X = V \times 0·926$. Where X equals volume of air of 20·80 per cent and V the volume of nitrogen in cubic feet, the corrected figures being—

Nitrogen..	101,158·4
Air of 20·80 per cent ..	93,672·6
	194,831·0

Cubic feet of residual gases containing 10·00 per cent of oxygen at the temperature of 15·555° C. and Bar. 760 m.m. air taken as containing 20·80 per cent of oxygen.

In practice we have to deal with pyrites containing, we will assume, 47·5 per cent of sulphur as FeS_2, as well as small quantities of lead, zinc, arsenic, &c. For practical purposes we may neglect the effect of these, and also of the nitrate of soda used; the ultimate figures will be but little affected by our doing so.

The general formula for calculating the available sulphur in the pyrites is :—

$$A - \frac{(B \times W)}{100}$$

Where A = per cent of sulphur in pyrites.
B = ,, ,, in residue.
W = weight of residue from 100 of pyrites.

With pyrites of 47·5 per cent of sulphur, yielding 70 per cent of its weight of residue, containing 3·57 per cent of unconsumed sulphur, we have—

$$47·5 - \frac{(3·57 \times 70)}{100} = 45 \text{ per cent available.}$$

Assuming this to exist as FeS_2, the volume of nitrogen due to the combustion of one ton of the above pyrites is obtained by the equation.

$$A - \frac{(B \times W)}{100} \times C = X.$$

C being a constant for air of 20·8 per cent of oxygen = 1897·9, and the air associated with the nitrogen by $X \times C' = Y$,

C' being a factor corresponding to the percentage of oxygen in the escaping gases.

Then X + Y = total volume of residual gases.

Taking oxygen in residual gases to be 10 per cent after condensation or absorption of all sulphuric gases (either in chambers or absorbers employed in testing) we have for the case we are considering of pyrites of 47·5 per cent, &c.

Nitrogen Volume.		Nitrogen Volume.		Total Volume.
85,405·8 × 0·926	=	79,085·8	+	85,405·8 = 164,491·6 cub. ft.

The total volume of residual escaping gases from one ton of pyrites, such as we are considering, 20 cwts. of which at 45·00 per cent available sulphur, will yield—

7,056,000 grains of sulphur,

which, divided by the cubic feet of residual gases escaping, would give 42·9 grains per cube foot were all the sulphur to escape; and as 100 of sulphur equals 306·25 H_2SO_4, 42·9 grains per cube foot escaping would represent a loss of 306·25 H_2SO_4 on 100 of sulphur available, and consequently one grain of sulphur per cube foot equals a loss of 7·139 H_2SO_4 from 100 available sulphur.

Further, the available sulphur being in this case 94·737 per cent of the "sulphur bought," one grain of sulphur per cube foot equals—

$$\frac{94·737 \times 7·139}{100} = 6·76$$

Loss of H_2SO_4 from 100 of "sulphur bought."

If the $BaSO_4$ is weighed in grammes, then grammes of $BaSO_4$ per cube foot × 14·26 will give the loss in terms of H_2SO_4 per cent on "sulphur bought," or × 15·06 will give loss on "sulphur burned."

The meter, absorbing arrangements, and all cocks and

connections are in locked cupboards to prevent their being tampered with.

The meter is fitted with an index so arranged that by observing the reading for one minute the rate of passage per hour is given by direct indication, so that the rate of aspiration is easily regulated.

The pump may be constructed in various ways, the simplest form, which is a very efficient one, being a simple ⊢ tube, the water being let in at the side. It is an advantage to have a trap introduced on the discharge pipe from aspirator, by which means a greater command is obtained over the apparatus.

The absorbing arrangement may be fitted up in so many ways that it need not be described here; in fact, so long as there is sufficient absorbing liquid to arrest the largest possible escape in an efficient absorbing apparatus, it matters little what is the arrangement adopted.

Caustic soda or ammonia, free from sulphur salts, are very suitable as absorbents, and it is as well to use a tube of permanganate of potash solution as a final washer to indicate if any excess has been passing over what has been absorbed in the apparatus.

An idea of the SO_2 escaping is readily got by titrating the solution from the absorbing tubes with permanganate; this can be done very rapidly, and is a good check on the working.

I have found that it is practically impossible to obtain steady results from sulphuric acid chambers worked on the ordinary system of inspection alone, by which I mean the indications afforded by colour (and smell!) of gas, drip samples, temperatures, &c., for while all seems to be going on rightly, the escapes vary in the most irregular way, and it is not until a considerable time after an irregularity has occurred in the working that it can be discovered by these indications; whereas on the other hand, by means of the check on the working of the chambers obtained by the continuous testing of the escapes, the management of the process is much simplified, and it can at once be discovered in the case of an excessive escape what has been the cause, when of course it is easily prevented.

The application of the apparatus I have described to sulphuric acid chambers, previously worked on the best known methods, has had the effect of at once reducing the escapes to a large extent.

PROCEEDINGS OF SOCIETIES.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

July 23rd, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

PROF. H. W. VOGEL exhibited an ingenious "*Support for a Pocket Spectroscope*," by means of which the latter could be easily used for the accurate comparison of absorption-spectra and of flame spectra, or of either with the solar spectrum.

Prof. H. WICHELHAUS and M. SALZMANN communicated the results of an investigation "*On the Constitution of Euxanthone*," the body $C_{13}H_8O_4$, obtained from the Indian dyestuff puree. It was found to form an acetyl compound containing two acetyl groups. On reduction with zinc it yielded benzene, phenol, and as chief product a solid body, $C_{13}H_8O$, which was easily oxidised to $C_{13}H_8O_2$. These reactions, combined with the other well-known decompositions of euxanthone, led to the establishment of the following series of formulæ, according to which euxanthone would be the carbonyl of resorcin :—

$$C_{13}H_8O = CO\begin{matrix}C_6H_4\\C_6H_4\end{matrix}\!>\text{Carbodiphenylen.}$$

$$C_{13}H_8O_2 = CO\begin{matrix}C_6H_4\\C_6H_4\end{matrix}\!>O\text{, Carbodiphenylen oxide.}$$

$$C_{13}H_8O_4 \quad CO\begin{matrix}C_6H_3\cdot OH\\C_6H_3\cdot OH\end{matrix}\!>O\text{, Euxanthone.}$$

Prof. WICHELHAUS presented for Dr. Förster a paper "*On Amin. Derivatives of the Amylic Series.*" The action of alcoholic ammonia on amylen bromide leads to the formation of several bases. The one chiefly examined is $C_5H_{10}(NH_2)_2$, which forms a finely crystallising compound with $PtCl_4$.

Prof. C. LIEBERMANN has investigated the "*Composition of Quinhydrone*," the green compound resulting from the union of solutions of quinone and hydroquinone. It has hitherto been uncertain whether it contained 2 molecules of quinone and 1 of hydroquinone, or the reverse, or 1 molecule of each. In order to solve the question equal weights of quinone and hydroquinone were dissolved in water, and the solutions brought together. The resulting precipitate of quinhydrone was found to weigh but 7 per cent less than the original amounts, and by a determination of the solubility of quinhydrone most of this difference was accounted for. An increase of the amount of quinone solution to a fixed amount of hydroquinone solution produced no increase in the amount of the precipitate beyond that resulting from the action of equal weights upon each other. The same fact was found to be true for thymoquinone and thymo-hydroquinone. Quinhydrone must receive, therefore, the formula $C_{12}H_{10}O_4$.

Dr. C. O. CECH has prepared "*Mono-chlor-acetanilide*" by the direct action of aniline on mono-chlor-acetic acid, and finds the melting-point to be 134°.

Prof. A. W. HOFMANN has examined "*A New Dyestuff*," of a bright red hue, which has lately been placed upon the market, and found it to belong to the same general class of bodies as the chrysoidin lately investigated by him (CHEMICAL NEWS, xxxv., 64). Analysis showed it to be the sodium salt of an acid, $C_{16}H_{12}N_2SO_4$. A body of this composition could be regarded as arising from the union of azo-sulphanilic acid and α-naphthol, or from diazo-naphthalen and a phenol-sulphonic acid, or from azo-naphthylamin-sulphonic acid and phenol, or finally from naphthol-sulphonic acid and diazo-benzol. The latter method was considered the most probable. A solution of sodium α-naphthol-sulphonate added to a solution of aniline nitrate and potassium nitrite yielded at once a deep red precipitate of notable tinctorial power. Purification by solution in ammonia, and precipitated with acids, showed the new acid to be perfectly identical with that obtained from the commercial dye.

Dr. F. TIEMANN and K. L. REIMER, "*On the Phenol-dicarbonic Acids Derived from Salicylic and Paroxy-benzoic Acids.*" The authors, in the endeavour to study more thoroughly the three aldehydo-oxy-benzoic acids, derived from salicylic acid and paroxy-benzoic acid, have submitted them to oxidation. The process is exceedingly difficult, and is not furthered by introducing an acetyl group into the hydroxyl group. It was observed that a careful fusion with KHO produced the same results as oxidation with argentic oxide or potassium permanganate, no molecular condensations taking place. The two aldehydo acids, $C_6H_3(COOH)(OH)(COH)$, 1.2.5 and 1.4.5, yielded the same identical acid—the α-phenol-dicarbonic acid, which Ost has already prepared in a different way—as would be expected from the present benzene theory. The acid, $C_6H_3(COOH)(OH)(COH)$, 1.2.3, yielded a new acid, named β-phenol-dicarbonic acid, which can be considered as a double salicylic acid. The solution shows a fine blue fluorescence. Salicylic acid is formed by the sublimation of the solid acid.

Dr. F. TIEMANN and N. NAGAI, "*Synthesis of Ferula Acid, and Relations of this Acid to Caffeic Acid and other Members of the Protocatechuic Series.* The authors have

prepared ferula acid by means of Perkin's reaction from vanilline directly. The methyl-ferula acid is found to be identical with the dimethyl-caffeic acid, so that ferula acid must be considered as methyl-caffeic acid. By reduction hydro-ferula acid is obtained, and an iso-ferula acid has been prepared from methyl-ferula acid. The authors have now clearly settled the relations between the three homologous groups of the protocatechuic series :—

$$C_6H_3\begin{cases}COOH\\(OH)_2\end{cases},\quad C_6H_3\begin{cases}CH_2.COOH\\(OH)_2\end{cases},$$

$$C_6H_3\begin{cases}CH_2CH_2COOH\\(OH)_2\end{cases},$$

and prepared the various methyl derivatives, with the exception of an iso-homo-vanillic acid.

Dr. F. Tiemann and K. U. Matsmoto have prepared a number of "*Derivatives of the Isomeric Methyl-protocatechuic Acids.*" These include more especially various ethers, and nitro and bromo compounds. Bromo-dimethyl-protocatechuic acid, when melted with HKO, is changed readily into gallic acid. The most favourable conditions for the preparation of iso-vanillic have also been studied.

The following communications have been received from non-resident members :

R. Otto finds that the solid "*Dichloro-propionitrile,*" obtained by the action of Cl on propionitrile, is a polymer of the liquid compound obtained at the same time, and that it is well adapted to yield higher condensation products. By treatment with finely-powdered silver meconic acid and similar compounds are prepared.

B. Tollens, "*Specific Rotatory Power of Cane-sugar.*" The rule that this power is proportional to the strength of the saccharine solution is not found to be applicable for all cases, and the limits are established within which it is correct.

H. Schmitz presents a communication on the same subject.

H. Hessert prepares "*Phthalic Aldehyd*" by the action of Zn and HCl on phthalic chloride. By treatment with alkalies the aldehyd is changed into a monobasic acid, which appears to contain the original compound plus water. Sodium amalgam yields the body $C_8H_6O_2$, the formula of which must probably be doubled, as oxidation changes it into diphthalic acid.

A. Baeyer, "*Regularity in the Melting-points of Homologous Compounds.*" The author detects in the melting-points of the normal acids of the oxalic series a peculiar regularity, those containing an unequal number of C atoms melting always lower than those containing an equal number; thus—

$C_4H_6O_4$	180°	$C_5H_8O_4$	97°
$C_6H_{10}O_4$	148°	$C_7H_{12}O_4$	103°
$C_8H_{14}O_4$	140°	$C_9H_{16}O_4$	106°
$C_{10}H_{18}O_4$	127°	$C_{11}H_{20}O_4$	108°

It is also noticeable that in the one series the melting-point ascends, while in the other it descends. A similar regularity, although with ascending melting-points in both series, is to be noticed in the normal fatty acids.

"*Derivatives and Constitution of Furfurol.*" By treatment with HI and amorphous phosphorus furonic acid yielded hydro-furonic acid, $C_7H_{10}O_5$, and the α-pimelic acid, $C_7H_{12}O_4$, of Dale and Schorlemmer. The author then brings together the evidence in proof of the presence of the chain-formed group, C_4H_4O, in furfurol.

A. Baeyer and P. Tönnies, "*Furfur-angelic Acid and Furfur-butylen.*" It is found that Perkin's reaction for the condensation of aromatic aldehyds with acetic anhydride can be used also with furfurol. Sodium butyrate, butyric anhydride, and furfurol yield on heating furfur-angelic acid, $C_4H_3O.CH=CHCH_2CH_2CO_2H$, which sodium amalgam reduces to normal furfur-valerianic acid. Isobutyrate of potassium and isobutyric anhydride act, however, quite differently with furfurol. At a low temperature CO_2 is driven off, and the reaction leads to the formation of furfur-butylen, $C_4H_3OCH=CHCH_2CH_3$, a colourless oil, boiling at 153°.

G. Wyss, "*On Glyoxalin.*" The preparation from aldehyd is described. As acetyl chloride and benzoyl chloride form no compounds with glyoxalin, it seemed to be a tertiary base. Other reactions would seem to prove the presence of the group NH. With ethyl bromide it formed the base—

$$C_3H_3N_2\begin{cases}C_2H_5Br\\C_2H_5\end{cases}$$

and with benzyl chloride—

$$C_3H_3N_2\begin{cases}C_7H_7Cl\\C_7H_7\end{cases}$$

Bromine changes it into tribromo-glyoxalin, $C_3HBr_3N_2$, which possesses acid properties, and shares with prussic acid the distinction of being the only organic acids containing neither oxygen nor sulphur. It forms white insoluble salts with the heavy metals, and the silver-salt gives ethers with CH_3I and C_2H_5I, which crystallise well. By the action of sodium amalgam on these ethers methyl- and ethyl-glyoxalin are obtained in the form of colourless oils. Silver nitrate forms, in a solution of glyoxalin, $C_3H_3AgN_2$, which yields also the ethers with the above-mentioned iodides. These reactions lead to the adoption of the following formula for glyoxalin :—

E. Schmidt, "*Polysulphhydrates of Brucine.*" The two derivatives formerly prepared by the author have been analysed by Hofmann's method, and found to possess the formulæ $(C_{23}H_{26}N_2O_4)_3(H_2S_6)_2$ for the red compound, and $(C_{23}H_{26}N_2O_4)_3H_2S_6$ for the yellow compound.

V. Meyer finds that "*Triethyl-benzyl Ammonium Iodide*" does not pass over into a triethylamine by distillation with HI, as asserted by Ladenburg.

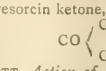
A. Fleischer and W. Hanko find the "*Distillation Products of the Xanthates*" to be CS_2, $(C_2H_5)_2S$, $(C_2H_5)_2S_2$, and COS, or C_2H_6S, CS_2, C_2H_6O, $(C_2H_5)_2S$, $(C_2H_5)_2S_2$, CO_2, and SH_2, according as the anhydrous or crystalline salts are used.

A. Fleischer and G. Nemes have examined the "*Action of Nitric Acid upon Carbanilide,*" and found the result to be tetra-nitro-diphenyl urea.

A. Schuller and V. Wartha, "*Calorimetric Investigations.*" The authors describe a slightly modified form of Bunsen's calorimeter adapted for the determination of the heat of combustion, and experiments on the combustion of H and O. The heat developed by the combustion of 1 grm. of H to H_2O is 34,126 grm. calories, slightly higher than observed by Andrews and by Thomson.

A. Claus and H. Graeff, "*Action of Sodium Amalgam on α-Nitro-naphthalen-sulphonic Acid.*" Instead of yielding an azo-naphthylen, as expected, this reaction causes a decomposition into naphthylamin and H_2SO_4. The nitro-benzene-sulphonic acids are, however, easily changed into the corresponding azo-compounds by this reaction.

A. Claus and H. Andreæ have obtained, by the "*Action of Oxalic Acid on Resorcin at a High Temperature,*" a di-resorcin ketone,—



O. N. Witt, *Action of Primary Amines on Diphenyl-nitrosamine.*" The reaction, which is quite violent, produces, in the case of aniline, diazo-amido-benzene, amido-azo-benzene, diphenylamin, and small quantities of a new substance crystallising in ruby-red needles. It receives the formula $C_6H_5.N.N.C_6H_4.N[N(C_6H_5)_2]_2$, is regarded as the first representative of a new class of bodies, the tri-azo-compounds, and is obtained in larger quantities by heating amido-azo-benzene, diphenylamin, and aniline at 125°.

R. Gnehm and G. Wyss, "*Nitro-Derivatives of Diphenylamin.*" Diphenylamin, methyl-diphenylamin, and diphenyl-nitrosamine all yield—by treatment with HNO_3 in an acetic acid solution—tetra-nitro-diphenylamin, $HN[C_6H_3(NO_2)_2]_2$. It crystallises in yellow needles, forms brilliant scarlet solutions with alkalies, and imparts

directly to wool and silk a fine yellow tint. The insoluble character of the compound prevents its application as a dye. Reduction yields an extremely unstable base, probably tetramide-diphenylamin. Tetra-bromo-diphenylamin is changed by the action of HNO_3 into dinitro-tribromo-diphenylamin, $NC_{12}H_6(NO_2)_2Br_3$.

O. Hesse, "*On some Lichen Colouring-Matters.*" The author shows that the acid previously obtained by him from *Usnea barbata* is carbonusnic acid, in opposition to the statements of Paterno. He has further detected in its company small quantities of a new acid, $C_9H_{10}O_3$, which receives the name usnetic acid.

F. C. G. Müller details several experiments in proof of the theory that the "*Temperature of the Aqueous Vapour escaping from Boiling Saline Solutions*" is but 100° at the moment of the formation of the vapour, and rises afterward by conduction, as in ordinary cases of superheated steam.

E. Fischer, "*Aromatic Hydrazin Compounds.*" A number of reactions with phenyl-hydrazin are described. Furfurol unites with it, under separation of a molecule of water. With cyanogen gas a base, $C_6H_5.N_2H_3(CN)_2$, is obtained. Heating with sulphur decomposes the compound chiefly to aniline. With diazo-benzene it yields diazo-benzene-imide, which is also formed by the action of I on the emulsion in water. By heating with $K_2S_2O_7$ potassium phenyl-hydrazin-sulphonate is obtained, which is easily oxidised to potassium diazo-sulphonate. From the various connections with diazo-benzene the author regards the formula $C_6H.NH.NH_2$ for phenyl-hydrazin as placed beyond doubt.

C. Reischauer, "*On the Formation of Mycoderma.*" A number of observations and analytical experiments on the influence of *Mycoderma* on beer are recorded, and accompanied by analyses of various beers.

J. Thomsen finds that "*Baric Iodide,*" when crystallised under normal circumstances, contains $7H_2O$, and regards the formation of a salt with $2H_2O$—as given by Werther—as problematical.

K. Heumann has prepared, by the "*Action of Alkaline Haloid Compounds on Silver Ultramarine,*" blue and green ultramarines, containing K, Na, Li, &c., in the place of silver.

P. Claesson, "*Action of* KNSC *on Derivatives of Mono-chlor-acetic Acid.*" Sulpho-cyan-acetic acid is prepared by the action of KNSC on the aqueous solution of sodium mono-chlor-acetate, in the form of a colourless, odourless oil. Various salts and ethers are described. The salts yield, upon treatment with HCl, carbamine-thio-glycollic acid, easily decomposed by salts having an affinity for sulphur. By the action of mono-chlor-acetic acid on sulpho-carbamide, as well as by the action of HCl on the ether of sulpho-cyan-acetic acid, the author obtains an acetic mustard-oil, $H.O.COCH_2NCS$, crystallising in colourless laminæ and possessing weak acid properties.

P. Jannasch prepares "*Para-xylol from Dibrom-benzene*" in quantities, by treatment with Na and CH_3I.

The Society adjourns until October 15th.

The Miraculous Pen.—We have received from Messrs. Mawson and Swan samples of a new pen which will, we think, serve a useful purpose. It is called "The Miraculous Pen," for writing without ink. It is used like an ordinary pen, but dipped into water instead of into ink. The ink which this pen generates instantaneously is always limpid, dries rapidly, and remains fixed and unalterable on the paper, and the writing obtained with it may be copied by the press. The chemical composition which is fixed to it is said to be concentrated to such a degree that each pen in ordinary use lasts at least several months. These pens are prepared with different colours, such as dark purple, red, dark blue, black, &c., and to write in these various colours a single little glass of water in the office is sufficient.

NOTICES OF BOOKS.

Chemical Composition of Foods, Waters, Soils, Minerals, Manures, and Miscellaneous Substances. Compiled by E. T. Kensington, F.C.S. London: J. and A. Churchill.

This work contains a considerable quantity of information, useful, and at the same time somewhat difficult to procure. Not merely the outside public, but professional chemists, if suddenly asked what is the average composition of such or such a body, are at a loss where to look for an immediate answer. Mr. Kensington's compilation therefore supplies a want which must have been often felt. If we point out certain defects which in our opinion somewhat interfere with the value of the book, we are actuated not by a desire to find fault, but by the wish that future editions may be rendered still more serviceable to the public. Thus it would be an improvement, in our opinion, if each analysis showed its authority and its date. A more particular description of the origin and nature of the article analysed would in certain cases be very useful. Thus, on p. 100, we find "Manure, detailed composition," but whether it is stable manure or general farm-yard manure, and what is its condition, we do not learn. On turning to p. 103, however, we find another less detailed analysis of "Manure, mixed long fresh dung in natural state." On comparing the figures we find that the two samples are identical.

An analysis of cockchafers, placed rather oddly in an Appendix otherwise devoted to articles of food, makes no mention of chitin, but gives 16·06 per cent of "fibre."

In the analyses of wines "absolute alcohol" and "proof-spirit" are given as if they were two distinct and co-existent constituents. This will not mislead chemists, but is very likely to puzzle the general public. It is surely time that the term "proof-spirit," utterly arbitrary and incomprehensible to half the world, should be discarded in stating the composition of wines, malt liquors, &c.

In an analysis of soda-waste—which by the way shows none of the valuable fertilising constituents a certain inventor has been pleased to find in this refuse—we see the item "Silicate of manganese, 6·91 per cent." This is utterly incomprehensible save on the supposition that the author meant to say silicate of magnesia. In a sherry from the "Pure Wine Association" we find the total solids given as 3·47 per cent; yet the grape-sugar alone is stated as 3·26 and the tartaric acid at 0·33, thus already exceeding the total of solid matters.

An analysis of "Russian salt produced by the freezing process" is very interesting. As obtained at Oustkout it contains—

Chloride of sodium	74·84
,, of aluminium	1·17
,, of calcium	5·21
,, of magnesium	3·57
Sulphate of soda	15·21
	100·00

We have no desire to make what a certain chemist calls a "dietetic examination" of such an article.

In a second section of manures—which might have been more conveniently placed along with the former group (pp. 94 to 106)—we meet with a "Liquid Manure," possibly the drainage of a cesspool or a heap of farm-yard manure; but its exact nature and origin ought to have been mentioned. Not far off we come upon the analysis of a wheat-manure, likewise of unknown origin. We can hardly consider it as a model showing what a wheat-manure ought to be, since it contains common salt to the extent of 16·84 per cent. If salt is needed the farmer can certainly add it to his soils at a lower figure than the price of any wheat-manure in the market.

On the same page figures the analysis of a "British Economical Manure":—

Moisture	9·86
Green vitriol	25·81
Sulphate of lime	2·05
Common salt	13·39
Bisulphate of soda	30·69
Sand	15·20
	100·00

Nitrogen .. .. 0·06.

Such an article must be much more economical to the seller than to the consumer. In a sample bearing the same name, which once fell into our hands, we found sulphates of copper, zinc, and lead,—in short, a medley such as might be formed from the refuse of ill-managed chemical works.

We hope that in future editions the author will see his way to the removal of such flaws as we have felt it our duty to point out.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 1, July 2, 1877.

Researches on Anhydrous Chloral and on its Hydrate.—M. Berthelot.—Experiment shows that heat is liberated in the reaction of gaseous chloral upon gaseous water, with formation of a gaseous compound. Hence a gaseous chloral hydrate really exists as distinct from a mere mixture of the two vapours. This conclusion agrees with the results obtained by M. Troost from the study of the tensions of dissociation. It is supported by the fact that anhydrous chloral in vapour does not combine instantaneously with water, but condenses in it at first in the form of an oil which only dissolves gradually even on agitation; whilst the vapour of chloral hydrate, on the contrary, condenses under water in the state of crystalline hydrate, except agitated.

Researches on the Compressibility of Liquids.—M. E. H. Amagat.—The liquids examined are ethers, alcohols, benzol, aceton, chloroform, and bisulphide of carbon. The results are given in the form of a table.

Vapour of Chloral Hydrate.—M. L. Troost.—The author's former results on the volume-equivalent of chloral hydrate having been called in question by M. Wurtz, he has repeated his experiments, and arrives at the same conclusion given in his former paper (lxxxiv., p. 711) in which the volume-equivalent in question is stated =8.

Dissociation of Hydriodic Acid in Presence of an Excess of One of its Elements.—M. G. Lemoine.—The author calls attention to the stability which an excess of one of its elements gives to the compound. On mixing hydriodic acid with increasing quantities of hydrogen the proportion of the acid which is dissociated is diminished by about the half.

Dissociation of Ammoniacal Salts in Presence of Metallic Sulphides.—P. de Clermont and H. Guiot.—The chloride and sulphate of ammonium, as well as the salts of organic acids, are dissociated when heated along with the sulphides of manganese, silver, and probably of other metals. This fact explains the difficulty encountered in the determining manganese with ammonium sulphide in presence of ammoniacal salts, as observed by Terreil, Spiller, How, and Claessen. The ammoniacal salt dissolves the manganese sulphide in the cold without decomposing it. On the application of heat the acid liberated in consequence of the dissociation of the ammoniacal salt decomposes a certain quantity of the manganese sulphide, forming a soluble manganese salt, which is only precipitated on adding a fresh dose of ammonium sulphide.

Use of Boron Fluoride as a Dehydrating Agent.—M. F. Landolph.—The author describes the behaviour of the reagent in question with camphor anethol, benzylic aldehyd, chloral, and ethylen.

Ordinary Presence of Copper and Zinc in the Human System.—F. Raoult and H. Breton.—The authors consider that the presence of these metals in the bodies of animals has been admitted by toxicologists for some time.

Ponderable Determination of Ozone in the Atmosphere.—M. Albert Levy.—The author's determinations are founded on the conversion of sodium arsenite and free arsenious acid respectively into sodium arseniate and arsenic acid. He finds that the platinum, which in his apparatus comes in contact with the liquid, has no disturbing influence.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. July, 1877.

Manufacture of Eburine.—M. Latry (a report presented by MM. Cloëz and Davanne on behalf of the Committees of the Chemical Arts and the Fine Arts as applied to Industry).—Eburine is a composition formed from the dust of ivory or bone cemented together with gum tragacanth or albumen, and coloured at pleasure. In some cases pressure and heat render the addition of any glutinous matter unnecessary.

Preparation of Celluloid.—Paper is treated by a continuous process with 5 parts of sulphuric acid and 2 of nitric acid, which convert it into a sort of gun-cotton. The excess of acid is removed by pressure, followed up by washing with abundance of water. The paste when thus washed, drained, and partially dried, is ground in a mill, mixed with camphor, ground again, strongly pressed, dried under a hydraulic press between leaves of blotting-paper, cut, bruised, laminated, and compressed again in a special apparatus suitably heated. It is said to be hard, tough, transparent, elastic, fusible, becoming plastic and malleable at 125°. It ignites with difficulty, is decomposed suddenly at 140° without inflammation, and gives rise to reddish fumes. It is inodourous, and does not become electric on friction.—*Bull. de la Soc. Industrielle de Rouen.*

Les Mondes, Revue Hebdomadaire des Sciences, No. 11, July 14, 1877.

On the Non-poisonous Properties of Magenta and of Wines coloured therewith.—Dr. Bouchut.—The author considers that magenta, in small doses at least, is not poisonous, but holds that its use in the manufacture of spurious wines is still a punishable fraud.

NOTES AND QUERIES.

Petroleum.—Will some reader oblige by indicating the best source of information upon the commercial valuation and preparation for market of crude petroleums and paraffins? An English work preferred.—HYDROCARBON

Commercial Sulphuric Acid.—Referring to Mr. W. M. Watts's letter in the last number of the CHEMICAL NEWS (vol. xxxvi., p. 42), I beg to say that our firm, the Melincrythan Chemical Company, Neath, will be happy to supply him with any quantity of sulphuric acid perfectly free from arsenic at 1d. per pound in carboys here.—HENRY B. GIBBINS.

Commercial Sulphuric Acid.—I should recommend your correspondent, Mr. W. M. Watts, to use sulphuric acid made from spent oxide, which I have found very free from arsenic. It rivals sulphur acid in appearance, the only impurity being a trace of iron, which will not interfere with his boys' experiments, and it may be obtained for little more than a penny per pound. The nearest place that I know of where it may be got is Messrs. Spence, Bros., Bradford, Manchester.—J. NAPIER, Bramford, Ipswich.

THE CHEMICAL NEWS.

VOL. XXXVI. No. 924.

ON REPULSION RESULTING FROM RADIATION.—PART IV.*

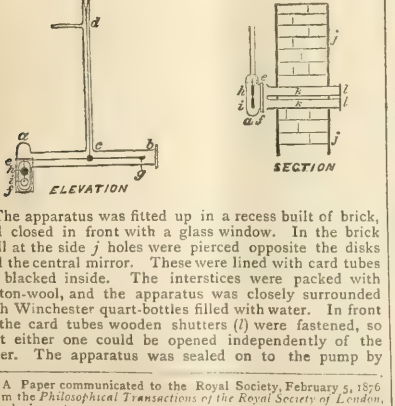
By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 47.)

198. I HAVE hitherto taken it for granted that a lamp-blacked surface is the most repelled by radiation, and that a white surface, such as that of freshly cut pith, is the least repelled. Experiments tried repeatedly with other surfaces abundantly confirm this supposition. It was necessary, however, to get accurate data on this point; and I have accordingly fitted up an apparatus which will enable me to measure the force of radiation and its action on disks of various materials of the same size, compared with a standard black disk.

The apparatus is represented in fig. 16. It is similar in principle to the torsion-apparatus already described (186). *ab* is the horizontal tube containing the glass torsion-beam; *c d* is the suspending fibre, also of glass. In the centre of the beam is a mirror, from which an index ray of light is reflected. The end *a* of the horizontal tube is sealed on to a wider piece of tube in a vertical position, and having in front of it a large opening (*e f*) occupying the whole of one side of the piece of tube; this opening has the edges ground perfectly flat, and is closed with a piece of plate glass cemented on. The object of the opening is to enable the disks to be changed. At the end (*b*) of the horizontal tube is another opening, closed in like manner with a plate of glass. This is to give access to the pan (*g*) of the beam, so as to counterpoise the disks, as they are not all of the same weight. At the other end of the beam a light aluminium bar hangs, on which is cemented the standard disk *h* and the movable disk *i*. The standard disk is of pith, coated with lampblack by holding it over the flame of burning turpentine. The movable disk may be of any substance.

FIG. 16.



The apparatus was fitted up in a recess built of brick, and closed in front with a glass window. In the brick wall at the side *j* holes were pierced opposite the disks and the central mirror. These were lined with card tubes (*k*) blacked inside. The interstices were packed with cotton-wool, and the apparatus was closely surrounded with Winchester quart-bottles filled with water. In front of the card tubes wooden shutters (*l*) were fastened, so that either one could be opened independently of the other. The apparatus was sealed on to the pump by means of the arm shown at the upper part of the torsion-apparatus.

With nothing in the pan, and only the standard black disk on, the beam is in equilibrium; consequently each new disk requires a special counterpoise.

199. The following weights and measurements of the different parts of the apparatus were taken:—

Weight of glass beam, central stirrup, and mirror	3·0485 grains.
Standard black disk and aluminium bar	0·4635 grain.
Pan at other end of glass beam, acting as counterpoise for above	0·5263 ,,
Weight of white pith disk and support	0·2670 ,,
Counterpoise for ditto	0·3085 ,,
Length of arm from centre of support to centre of disk	99 millims.
Length of arm from centre of support to centre of counterpoising pan	84 ,,
Diameter of disks	17·25 ,,
Torsion of suspending fibre, in air, with glass rod (186) hanging to it	½ oscillation in 15·75 seconds.

200. The experiments were tried as follows:—The exhaustion having been carried to the utmost point, so that no increase in sensitiveness was produced by further working the pump, a standard candle was adjusted opposite the black disk and at a definite number of millimetres off. The deflection of the index ray of light was then taken on opening the shutter. After completing this observation, the beam was allowed to come to rest; the candle was then lowered till it was opposite the lower disk, and the deflection caused by it was again taken. These were repeated several times. The mean results of the first series are given in the following Table (the lower disk being plain white pith):—

Distance of candle from disks.	Screen interposed.	Deflection of index ray of light on millimetre-scale 1100 millims. from mirror.		Reduced to Black = 100.	
		Black disk.	White disk.	Black.	White
Millims.					
800	Nothing	192	32	100	16·7
900	,,	122	21	100	17·1
1200	,,	62	10	100	16·1
500	Cell of water	80	7	100	8·7
500	Alum plate	100	8	100	8·0
500	,, solution	76	7	100	9·2
500	Ammonia gas, 6 ins. thick, and cell of water	79	7	100	8·8
800	Ammonia gas alone	190	31	100	16·3

201. The lower disk was removed and replaced by a disk of pith thickly coated on one side with pure precipitated carbonate of lead. The disk weighed 0·499 grain, the counterpoise weighing 0·530 grain.

After complete exhaustion, the results of various experiments are shown in the following Table:—

Distance of candle from disks.	Screen interposed.	Deflection of index ray of light on millimetre-scale 1100 millims. from mirror.		Reduced to Black = 100.	
		Black.	Carb. Lead.	Black.	Carb. Lead.
Millims.					
800	Nothing	130	17	100	13·0
500	Iodine in disulphide of carbon	127	9·5	100	7·5

Instead, therefore, of carbonate of lead being a good absorber of the rays which produce motion, it is a better reflector than a plain white pith surface, owing probably to its superior whiteness.

202. Another black surface was now sought for to com-

* A Paper communicated to the Royal Society, February 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

pare with the standard disk. Pith coated with precipitated iodide of palladium was employed. The disk weighed 0·460 grain, and the counterpoise 0·491 grain. The results were:—

Standard Black.	Iodide of Palladium.	Reduced to Black = 100. Black.	Iodide of Palladium.
70	61	100	87·3

203. Plates of alum and of rock-salt were successively introduced into the apparatus, to be compared with the standard black disk. The apparatus was, however, not sufficiently sensitive to enable me to make satisfactory comparisons. The average of several observations (which, however, were not so concordant as I should have liked) were—

Standard Black.	Rock-salt.	Reduced to Black = 100. Black.	Rock-salt.
131	4	100	3

Standard Black.	Alum.	Reduced to Black = 100. Black.	Alum.
120	6	100	5

There was no action on either the alum or the rock-salt when a screen of water or of alum was interposed.

204. In consequence of some experiments tried by Professors Tait and Dewar, and published in *Nature*, July 15th, 1875, I fitted up a more sensitive apparatus for the purpose of carefully examining the action of radiation on alum, rock-salt, and glass. The apparatus was similar to the one described in par 186, there being, however, no window at either end. To the horizontal beam suspended by the glass fibre were attached a plate of alum at one end and a plate of rock-salt at the other. Each plate was perfectly polished and transparent, and measured 12·5 by 13·5 millims., and was 1·5 millim. thick. The deflection was produced by a candle placed opposite the crystalline plate under examination, and it was measured in the usual way by a reflected ray of light. The following were the results:—

Distance of candle from plate.	Deflection observed. Alum.	Rock-salt.	Reduced to alum = 100. Alum.	Rock-salt.
150 millims. ..	21	17	100	81
" " ..	22	17	100	77·3
" " ..	24	17	100	71
100 " ..	48	30	100	62·5
" " ..	43	26	100	60·4

The action on the alum was found to increase at each observation. A glance at the plate showed the reason. When it was first put in it was perfectly smooth and transparent. Before it had been long in the vacuum efflorescence commenced, and when the first observation was taken the surface of the alum plate was dotted over with small white specks, which increased in size and number as the experiments were continued. The opacity thus caused was apparently sufficient to account for the increased action of radiation upon the alum plate.

The pump was kept going the whole time, so that the water vapour evolved from the dehydrating alum might be carried away and prevented from interfering with the results, as it otherwise would have done (130). The last two experiments, however, show the effect of aqueous vapour.

205. To test the accuracy of the explanation that the opacity caused increased action, I coated two disks of pith, one with powdered rock-salt and the other with powdered alum, and tested them against lampblacked pith in a similar apparatus to the one described in par. 198. The deflections were—

	Black pith.	Powdered alum.	Powdered rock-salt.
	110	38	18
or reduced,	100	34·5	16·3

As will be seen on reference to par. 203, the ratio between the black disk and the plate of rock-salt was 100 : 3. Powdering the rock-salt has therefore increased the action 13·3 per cent. The much larger action of the powdered alum is probably due to the fact that crushing the crystals facilitates efflorescence *in vacuo*.

206. The alum and rock-salt plates were removed, a fresh alum plate ground and polished, and this and the rock-salt were coated with lampblack. They were then put into the apparatus as before, the black side being away from the source of radiation, so that the rays would have to pass through the crystal plates before meeting with the lampblack. The deflections were taken as soon as the vacuum was good. The deflections were—

	Blackened alum.	Blackened rock-salt.
	26	19
or reduced,	100	73

The rock-salt was more slow in its movements under the influence of radiation than the alum was, but they both return to zero equally well.

207. A very sensitive apparatus, similar to the torsion-apparatus described in par. 198, fig. 5, was now employed, and a clear polished disk of rock-salt and a thin disk of glass of the same size were placed therein. The apparatus was very well exhausted, and the deflections taken when the radiation from a candle was allowed to fall on either disk. The mean of several concordant observations was—

Rock-salt.	Glass.
39	40

I quote the following from the article in *Nature* already referred to:—"Prof. Dewar then proceeded to show that the heating of the disk was the efficient cause of the action. Two equal disks, one of rock-salt, the other of glass, were attached to the glass fibre. The rock-salt was inactive when the beam [from a candle] was thrown on it; the glass disk was active. The reason is evidently that the rock-salt is not heated, being transparent to heat, whereas the glass is opaque, absorbs the heat and is heated." It will be seen that I have failed to obtain this marked difference in action between rock-salt and glass, although the glass shell of the apparatus was as thin as was consistent with strength to resist the atmospheric pressure.

208. The action of radiation on surfaces of pith coated with thin layers of different substances is deserving of considerable attention. I have had an apparatus at work for several months past, in which six disks can be experimented with on the same beam and during the same exhaustion (similar to the arrangement described in par. 198, which held two disks). With this I have tried many hundred experiments, using the flame of a candle direct, or shaded by screens of water, alum, &c. The results are of much value, as showing that there is no definite connexion between the colour of a body and the mechanical action of radiation upon it. For instance, taking the movement of the lampblacked pith, under the influence of a standard candle, as 100°, I find that under the same conditions

	moves
Precipitated silver	° 56
Amorphous phosphorus	" 40
Sulphate of baryta	" 37
Red oxide of iron	" 28
Scarlet iodide of mercury and copper	" 22
Lampblacked silver	" 18
White pith	" 18
Rock-salt	" 6·5
Glass	" 6·5

These are only a few of the results I have obtained. The experiments will occupy some time to carry out with the completeness which they deserve, and I therefore propose to defer any further mention of them to a subsequent paper.

(To be continued.)

ON

SOME SIMPLE LABORATORY MANIPULATIONS.

By Dr. P. TOWNSEND AUSTEN.

II.

*Washing out Flasks by Inversion.**

To wash a precipitate out of a flask would seem to be an easy manipulation, but yet the extraction of the last particles is often a tedious operation. This is particularly true in the case of small grains of sand or mica in the analysis of silicates, as well as with heavy gelatinous precipitates.

By using the following simple method a flask may be washed out at a single operation.

1. The flask contains a hot liquid.—The flask, which ought for the sake of convenience to be half full, is suddenly inverted† in a dish, the larger the better, containing about as much liquid as in the flask. This operation requires a little skill. It is most easily performed by holding the mouth of the flask over the rim of the dish, then gradually inverting the flask, and, as soon as the liquid begins to flow out, suddenly inserting it, putting the mouth of the flask entirely under the surface of the liquid, and at the same instant bringing it by a swift movement to the middle of the dish. After a few seconds the cooling of the air in the flask occasions a partial vacuum, and the liquid rises in the flask. If the liquid has been at a boiling temperature the flask will be almost filled. After allowing the liquid to ascend the flask is firmly held by the neck with one hand,‡ while the other grasps the bulge. By gently shaking the flask the liquid slaps against the top (bottom) and sides, thus dislodging completely all adhering particles. A slight revolving motion is then given, and the heavy solid particles go quickly down through the neck of the flask into the dish. After all the substance has been removed the flask is gradually tilted and the liquid allowed to run out. This operation also requires a little skill. If a bent glass tube be introduced into the flask, a quick exit of the contained liquid is effected. Care must be taken that the dish holds easily the additional amount of liquid contained in the flask, and that the liquid in the dish is warm.

2. The liquid in the flask is cold.—The flask is inverted in the manner described. A bent tube is introduced into the flask and the air partly drawn out. The operation is then conducted as in the other case.‖

After this treatment it will be found that the flask is completely free from all adhering particles.

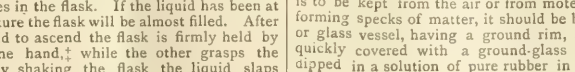
Crystallisation by Gradual Dilution.

It became necessary for me, not long since, to obtain some perfect crystals of a substance with which I was working, and I experienced considerable difficulty in obtaining solvents which would yield me the desired results.

The fact of argol being deposited by the gradual dilution of alcohol, wherein it is insoluble, struck me as affording a clue to the right manner of crystallising in general, and of this case in particular.

I dissolved the substance (dinitro-brom-benzol) in boiling glacial acetic acid, allowed the solution to cool to about 70°, and then added an equal volume of absolute alcohol, at a temperature of about 50°, stirring all the time. If the substance showed signs of separating prematurely a little more acetic acid was added. The mixture was then allowed to stand in a warm place. The crystallisation soon began. The formation of acetic ether* keeps pace with the separation of the crystals, so that as the substance is withdrawn from the solution, the water resulting from the formation of the ether dilutes the solution, thus keeping up a continuous separation. The ether may be allowed to evaporate, so that finally a very dilute acetic acid solution, containing but little of the substance, is left behind. I have tried this method with various substances and have been rewarded by beautifully formed crystals. I have noticed that many of the crystals obtained in this manner were remarkably transparent. The only requisites are naturally that the substance to be crystallised must be soluble in acetic acid, alcohol, and acetic ether, and insoluble in water.

It is often necessary to allow solutions to cool off very slowly. For this purpose I find the cork box, to which attention has so often been drawn, to be most admirable. The cork should be about an inch in thickness and covered with the pads of felt previously mentioned. If the liquid is to be kept from the air or from motes, or other nuclei forming specks of matter, it should be boiled in a beaker, or glass vessel, having a ground rim, and while boiling quickly covered with a ground-glass plate. A brush dipped in a solution of pure rubber in chloroform is run around the line of jointure of the two surfaces. This forms a connecting film impervious to both air and moisture.



I shall conclude this paper by drawing attention to a useful little instrument which has lately appeared. Its manner of action can at once be understood from the subjoined cut.

For cleaning flasks and tall beakers, wherein the hand cannot be introduced, it will be found extremely serviceable. A ball of wet newspaper grasped in the claws will be found excellent in cleaning beakers. A small towel or rag can be manipulated by means of it, with great effect on the inside of the flask. It is well to have several bent at right angles for cleaning flasks. It can also be used for pulling corks.

New York School of Mines,
April 10, 1877.

NOTE ON

ALKALINE CHLORIDES FOUND ON VESUVIUS.

By WATSON SMITH, F.C.S.

On descending a short distance inside the active crater, a fissure was observed which appeared to be partially filled with a hard white mass of some salt. This salt was so extremely hot, and at the same time so hard, that it was a matter of considerable difficulty to break off enough for a sample. There appeared to be from 8 lbs. to 10 lbs. weight of the salt in the fissure, and it had evidently been in a fused condition, afterwards hardening on cooling to some extent. An analysis of the salt gave the following results :—

	Per cent.
Potassium chloride	67·13
Sodium chloride	31·01
Potassium sulphate	1·86

* This method is not very applicable, however, to liquids holding light powders in *suspension*. By standing as in the silver assay and allowing the substance to settle, agitating occasionally to prevent its deposition on the bulge of the flask, even suspended powders may be removed.

† I much prefer this to corking the flask, inverting, and then removing the cork.

‡ Protected by a felt pad if necessary.

‖ It often occurs in analytical operations that the increase of volume in the liquid is not desirable. Excellent results may be obtained by rapid inversion of the flask in an empty dish. As soon as enough of the liquid has escaped to cover the mouth of the flask, the settling of the precipitate begins. The admission of air bubbles caused by the cooling of the liquid does no harm.

* $CH_3COOH + CH_3.CH_2.OH = CH_3.CO.O.CH_2.CH_3 + H_2O$.

ON SOME METHODS OF ESTIMATING TANNINS.*

By H. R. PROCTER, F.C.S.

THERE are few substances of equal importance to the tannins, of which the chemistry is in so unsettled a state. This is, no doubt, primarily due to their complexity and unstable character, which makes their investigation one of great difficulty; and, secondarily, to the indifference and ignorance of chemistry of those to whom the knowledge is of commercial importance. But tanners may be well excused for some distrust of chemical analyses when we consider the discordant results which are yielded by most of the processes in use. With a view to exhibit the relative merits of these processes, I have ventured to give the results of comparative experiments undertaken to test their accuracy, and to point out, if possible, those which merit confidence.

The process which has been brought most prominently before the public of late is that of Müntz and Ramspacher, which consists in forcing a tannin infusion through a piece of raw hide, taking the sp. gr. before and after, and calculating the tannin from the loss. In a paper which I communicated to this Society some little time since (*Proceedings*, iii., 213) I pointed out that the raw hide not only absorbed the tannin, but also a large proportion of the free acids in the infusion, thus, in some cases, causing a notable error. To this I may now add that it is extremely difficult to absorb the whole of the tannin, that the first portion of liquor which passes is invariably lighter than succeeding portions, and that the sources of error are so large in proportion to the quantities to be measured that the results are of little practical value. In proof of this I may mention that a series of nine analyses of the same sumach, well mixed, and kept in a tightly-corked bottle, gave results varying from 18 to 28 per cent, and a mean error for each single experiment of 3·15 per cent, or upwards of 13 per cent of the total tannin, while the mean value—23·9 per cent—was probably itself too high. In these analyses the utmost care was taken, and in each case the absence of tannin in the filtrate was proved by gelatin. If we assume that tannin is worth 20s. per ton per cent, which is not far from the truth, the chemical valuation of this sumach would vary from £18 to £28 per ton, with an average error of £3 3s., and obviously is far more erroneous than the merest guess. If any further proof of the inaccuracy of the method is needed, I may quote the results of a series of twelve analyses of a valonia by Mr. W. N. Evans, who, perhaps, has had more practice with the tan-tester than any other man in England. The average error exceeds 10 per cent of the whole quantity of tannin, and the money values vary from, say, £17 5s. to £28 10s. per ton.

The older method of Hammer, in which absorption by hide-raspings takes the place of the raw hide-filter, is in my experience still more inaccurate; and I cannot say that the slight modifications proposed by Nickerson are any improvement.

Another method which has long been in use is precipitation by volumetric solution of gelatin and alum. With a solution of 5 grms. of gelatin per litre I found it impossible to say whether tannin or gelatin was in excess, with less differences than about 4 per cent of the total quantity employed, and then the reactions were somewhat doubtful. These experiments were made with pure tannin; with catechu or gambier the uncertainty would be far wider, and with used tan-liquors it would be worse still. Under favourable circumstances and with great patience it is possible to obtain rough estimates by this method; but this is all I can say.

Concerning Sir H. Davy's still older method of precipitating with gelatin, filtering, drying, and weighing, and reckoning four-tenths of the whole as pure tannin, Dr. J. Watts says (*Pharm. Journ.*, viii., 517) it has "been shown to be both tedious and incorrect, as the solution refuses to filter, and the first portions precipitated contain a far larger proportion of tannin than do those which fall towards the end." Other chemists make the same statements, so that I had not thought it necessary to repeat their experiments. Very recently, however, I have learnt that Mr. Stoddart, of Bristol, and Mr. Dearden, of Bury, are again employing the plan, using sufficient alum to make the precipitate coagulate, and washing by decantation with boiling water. Mr. Stoddart informs me that the results agree fairly with a modification of Allen's lead method, which he employs. I therefore purpose trying it at a future time; but the results can scarcely be very accurate, and it is improbable that all tannins combine with gelatin in the same proportions. This last objection is technically of less importance, however, since the power of precipitating gelatin is probably *somewhat* proportionate to that of making leather.

Some years ago Fleck announced a method depending on the fact that while tannin, gallic acid, and colouring matter are all precipitated by cupric acetate solution, the two latter are re-dissolved by ammonic carbonate. He proposed, therefore, to employ a standard copper solution, and to estimate the excess by potassic cyanide. Dr. Watts showed that this was impracticable (owing to the fact, as I found, that cupric ammonio-gallate is not blue, but brown), but that gravimetrically some tannins might be estimated with considerable accuracy, while others gave precipitates more or less soluble in the ammonic carbonate. The precipitate is complicated, and contains ammonia. Schiff gives its formula, in the case of digallic acid, as $C_{14}H_4Cu_2(NH_4)_2O_9+OH_2$ (*Ann. Chem. und Pharm.*, clxxv., 171), which would give 1 grm. of tannin (digallic acid) = 1·54 grms. precipitate, and 0·494 grm. CuO_{14}. Watts, employing the number 1·489 (deduced from the assumption, now shown to be incorrect, that the salt was a simple cupric tannate), obtained analytical results fairly agreeing with those by gelatin for valonia, sumach, divi, oak bark, galls, and myrabolans; and also for mimosa, by employing the number 0·2959 instead of 0·489. All tannins giving green precipitates with iron gave copper precipitates more or less soluble in ammonia.

No doubt this method, reckoning the tannin as two-thirds the weight of precipitate, or twice that of cupric oxide left on ignition, would give fair technical results; but it is unlikely that all the various tannins actually combine with copper in the same proportions. In fact, as we shall see later on, the different tannins differ notably in their properties and reactions, only agreeing in their power of precipitating gelatin, and I fear tanners will have to give up all hope of measuring them by one common standard. Indeed, to a chemist to do so seems about as reasonable as to compare the values of nitric and sulphuric acids by a standard solution of hydrochloric acid. Probably the differences between gallotannic, quercitannic, and catechu-tannic acids are quite as great as those of the mineral acids I have named. Chemists may fairly undertake to compare sumach with sumach, or bark with bark, but the relative values of the tannins of bark and sumach are commercial matters which no analysis can decide, though it doubtless might be done by carefully conducted technical experiments.

The disadvantages of the copper method are that it is slow, troublesome, and difficult, and that the washing and drying must be rapidly and carefully done, as the precipitate is easily decomposed. This difficulty might be overcome by igniting, and weighing the CuO, but this can only be done easily in oxygen, as otherwise the copper is so much reduced that it is apt to deflagrate with nitric acid or ammonic nitrate. I think the best way is to filter on a vacuum filter, and dry in an air-bath (with a thermostat) at 100°.

The mean error of such result in a series of eight

* Read before the Newcastle-upon-Tyne Chemical Society, March 22, 1877.

analyses of commercially "*pure*" tannin, containing apparently about 85 per cent digallic acid by the total employed, was only ± 4·2 per cent, a much better approximation than any of the foregoing. It is not likely that the results with tanning materials would be quite so good. Analyses of bark showed considerable divergence, and combustion of the precipitate proved that it was somewhat inconstant in composition, the Cu varying from 21·6 to 25·4 per cent. I fancy, too, that for oak-bark tannin two-thirds of the weight of precipitate is decidedly too high an estimate. It must also be borne in mind that if lime be present, as is often the case with tan-yard liquors, it will be precipitated as carbonate. This might be prevented by filtering off the precipitate before washing with ammonic carbonate; but the method is troublesome enough without this, besides being of rather questionable accuracy.

Another process which has been much recommended is Mr. A. H. Allen's volumetric one, with a standard solution of acetate of lead, using as an indicator a mixture of ammonia and potassic ferricyanide. This is described in the last edition of Sutton, but in its original form is quite inadmissible, since lead precipitates gallic acid as well as tannin, and both react equally on the indicator. In combination with some of the differential processes in which the tannin is removed by gelatin or hide-raspings, it may no doubt give useful results, and, as the lead compounds of the different tannins are better known than most others, possibly factors might be calculated to give percentage results. I cannot insist too strongly that any calculation of percentages by comparison with "pure" tannin is utterly fallacious, both because the various tannins are of totally different constitution and because really pure tannin is quite unattainable. That met with in commerce only contains 80 to 90 per cent of really pure tannin, and is very variable.

Mr. Stoddart uses Mr. Allen's process in conjunction with absorption of tannin, with hide-raspings, when of course the loss is *proportional* to the tannin. He also employs Nelson's gelatin swollen in cold water as an absorbent in the same manner. Time and patience are necessary for the absorption of tannin thus, and it is seldom so complete that the results are not altered by prolonged digestion. In my experience the end reaction of Allen's method is not very distinct, and it is necessary carefully to filter the drops tested, as the indicator is affected by the precipitate. This makes the process somewhat tedious.

The remaining methods which I shall describe are all based on the oxidation of tannin by various agents, and all involve double analyses after absorption of the tannin, as tannin and gallic acid are almost identical in their behaviour with oxidisers.

Mittenzwey, and afterwards Terreil, proposed to estimate it by the direct absorption of atmospheric oxygen in alkaline solution—a difficult and tedious proceeding, though doubtless capable of some accuracy in skilful hands.

Monnier proposed to determine with permanganate direct, but this proved quite impracticable, since the oxidation is rapid at first, and then slow and with *no* definite termination.

To Dr. Löwenthal is due the capital improvement, which, with his recent additions, constitutes to my mind the most practical method of tannin analysis yet discovered. He adds to the *very* dilute tannin infusion a considerable quantity of indigo, not only to act as an indicator, but to control the oxidation of the tannin. This reaction is both rapid and accurate, and combined with his process of precipitation by gelatin will give results strictly comparative for any single tanning material. As it is likely to be of great practical importance I venture to give working details, referring for further particulars to Löwenthal's paper in the *Zeitschrift für Analytischen Chemie* (1877, p. 33), and to an excellent paper by Neubauer abstracted in the *C. S. Journal* (ix., 595).

Of solutions the following are required:

1. Four grms. pure permanganate of potash in 3 litres of distilled water (or half decinormal answers well and saves calculation).
2. Five grms. of *pure* "precipitated indigo" in 1 litre of water (Woodroof Brothers, of Crutched Friars, supply a satisfactory article).
3. Dilute sulphuric acid (1 to 3 of water).
4. Twenty-five grms. of good transparent glue well swollen in cold water, and then dissolved by the aid of heat. The solution is made up to a litre, and saturated with pure salt (table salt).
5. A saturated solution of pure salt, containing 25 c.c. of sulphuric, or 50 c.c. of hydrochloric, acid per litre.

To make an analysis, 10 grms. of sumach or valonia, or 20 to 25 of bark, are exhausted by repeated boiling with portions of water, and the infusion, when cold, made up to 1 litre.

Of this infusion 10 c.c. are mixed with, say, ¾ litre of good drinking water, 25 c.c. of the indigo solution, and 10 c.c. of the dilute sulphuric acid are added, and then the permanganate solution is run in *drop by drop* from the burette, with *constant* stirring, till the deep blue of the indigo changes to a clear yellow; and the moment this takes place we note the quantity of permanganate used. We will call this quantity A.

Next we repeat exactly the same process with the indigo and sulphuric acid alone, and will call the quantity B. Then, subtracting B from A, we obtain the amount of permanganate consumed by the total astringents of 10 c.c. of our tannin infusion. The permanganate acts, of course, as an oxidising agent, oxidising and consuming both the tannin and the indigo; but as the tannin is the most readily oxidised of the two it is consumed first, and when the indigo is all bleached we may be sure that the tannin is destroyed also. In order, however, to obtain this satisfactorily, the proportion of indigo should be such as to require about twice the quantity of permanganate which would be consumed by the tannin alone. Thus, if the indigo alone requires 10 c.c. of permanganate to decolourise it, the indigo and tannin infusion together must not take more than about 15 c.c., and if it does so the tannin infusion must be diluted accordingly, or a less quantity employed.

The next step is to ascertain the proportion of gallic acid and impurities in our sample. To this end we mix 100 c.c. with 50 c.c. of our salted gelatine solution, and *then*, after well stirring, add 100 c.c. of the salt and acid solution, and leave the mixture standing for some hours or all night, and then filter it through paper. The filtrate should be *completely* clear.

If we now test, say, 50 c.c. of this filtrate with permanganate and indigo as before, we shall obtain the amount of permanganate required for the gallic acid and impurities alone, since the tannin has been entirely precipitated, and the gelatine has so trifling an action on the permanganate that it may be safely neglected. To make the working clearer we will take an example from Dr. Löwenthal's paper:—

Ten grms. of sumach were boiled in ¾ litre of water, and after cooling were made up to 1 litre.

(1) 10 c.c. sumach infusion .. .. 25 c.c. indigo solution	consumed	16·6 c.c. permanganate.
Ditto repeated	16·5 ,,	,,
	33·1 ,,	,,
50 c.c. indigo alone	13·2 ,,	,,
Total permanganate for 20 c.c. sumach ..	19·9 ,,	,,

(2) 50 c.c. filtrate from the gelatine .. .. 25 c.c. indigo solution	consumed	11·2 c.c. permanganate.
Ditto repeated	11·1 ,,	,,
	22·3 ,,	,,
50 c.c. indigo alone	13·2 ,,	,,
Gallic acid and impurities ..	9·1 ,,	,,

Now, deducting 9·1 c.c. from 19·9 c.c., we have 10·8 c.c. as the permanganate equivalent to the tannin of 20 c.c. of sumach infusion, or 0·2 grm. of dry sumach. If it be desired to compare two sumachs, these proportional numbers are all that is necessary, and indeed it will be quite safe to use them for comparing sumach with galls or pure tannin. In the same way bark may be compared with bark, and valonia with valonia, but it will not be safe to attempt by this means to compare bark with sumach or with valonia, because the different species of tannin consome different proportions of permanganate. Oser states that 1½ grms. of oak-bark tannin consumes only the same quantity as 1 grm. of gall-nut tannin.

I may remark that where many analyses have to be performed the constant stirring becomes very tedious, and a stream of air-bubbles forced through the liquid by an aspirator may be substituted with great advantage.

Neubauer reckons 1 litre of decinormal permanganate as equal to 4·157 grms. of gallotannic acid, and consequently (according to Oser) to 6·235 of oak-bark tannin. Further research, however, is needed before percentages can be calculated with certainty, and chemists, in giving results, would do well to state the equivalent in permanganate, or to say that they use Neubauer's or Oser's equivalent. The first is applicable to sumach, galls, and myrabolans; the second probably to oak-bark, valonia, and chestnut extract, at least approximately. It is a singular fact that gallic acid consumes not only a larger proportion of permanganate, weight for weight, than tannin, but even a larger proportion than the tannin from which it is derived, as I proved by digesting a solution of tannin with dilute sulphuric acid, when its reducing power was notably increased. Hence commercial tannin, which is largely contaminated with gallic acid, consumes *more* permanganate than the above-mentioned quantity.

As to accuracy, single tests should never differ by more than 0·1 c.c., or say 2½ per cent of the total quantity; but of course, in so rapid a process, no one would rely on single tests, and by repeating and taking the mean any required accuracy may be attained. Separate portions of liquor precipitated by gelatine give identical results, at least within the limits named.

I should perhaps mention that Mr. Estcourt proposed some time since to precipitate with gelatine in conjunction with the permanganate method (Chem. News, vol. xxix., p. 110), but as he heated the solution, and tannate of gelatine is soluble in *hot* gelatine solution, the results were not satisfactory. Still he undoubtedly deserves the credit of the idea, while Löwenthal's *cold* gelatine solution, with the addition of salt and acid, completely overcomes the difficulty.

Several other oxidising methods have been proposed. Carpeni precipitates the tannin with ammonio-acetate of zinc, re-dissolves and estimates with permanganate. M. Jean oxidises with iodine in solution of sodic carbonate, and M. Pouchet with concentrated permanganate in a caustic potash solution. None of these methods seem to have any advantage over Löwenthal's, while the two latter are in my experience decidedly inferior. The end-reactions are much less distinct, and it is quite impossible to work them by artificial light, which is almost preferable with the indigo process, and is often a great convenience.

In speaking of the results I have obtained as a test of the accuracy of methods, I do not mean to convey that they are the *best* attainable, but simply such as would be likely to be obtained by a chemist of average skill and experience.

ON CERTAIN CHEMICAL EFFECTS OF OXYGENISED GRAPHITE AND PLATINUM.*

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand

In the experimental results I am about shortly to describe I do not for the present distinguish between graphite, &c., as combined with a compound of oxygen such as nitric acid, which easily gives up oxygen, or graphite, &c., as combined with oxygen alone, either as oxygen or ozone. In some of them it is most probable that this acid, or a product of it, as absorbed by the graphite, operates for their production, while in others it really appears that it is oxygen which is the sole operant.

But as all these experiments were carried on in the presence of nitrogen, a gas which is, as we know, susceptible of being acted upon in certain cases by oxygen in such a manner that nitric or nitrous acids result,—and, further, as nitric acid is, as I have long since shown, absorbed by charcoal, and also, as will presently appear, by graphite and platinum too,—I cannot therefore as yet unreservedly attribute any of these results to the action of absorbed oxygen alone, although, as previously stated, I incline to this view,

Having thus defined the position I would hold for the present in regard to the bearing of these results, I will at once state them. They are as follows:—

1. That any surface of graphite, native or artificial, which has been for some time exposed to the air, liberates iodine from a solution of potassic iodide in weak sulphuric acid.
2. That graphite, which can thus liberate iodine, loses this property when washed in ammoniacal or other alkaline solutions; also by ignition.
3. That this property of liberating iodine is restored to such graphite by a short exposure of it to the air, or by evolving nascent hydrogen against it; also by digesting it for a little while with hydrochloric or weak sulphuric acid, either at a common temperature or at the boiling-point of these acids respectively.
4. That graphite, which thus liberates iodine, also rapidly determines a chemical effect upon mercury, when voltaically paired with it in pure hydrochloric acid, mercurous chloride forming.
5. That platinum can be substituted for graphite in the above experiments, with the same general results.

I further find that charcoal does not, even when freshly prepared, notably liberate iodine; but it can be made to do so by digesting it with an acid, the effect of which is perhaps due to its removing all alkaline matters therefrom, and thus enabling the charcoal to retain the oxidising agent necessary for effecting the liberation in view.

Silver, also, liberates iodine from the solution of it I have named here, and gold even appears to do this, but to a much less extent.

Nitric acid has the same effect upon either graphite or platinum (in relation to iodine) as exposure to air has, and prolonged washing of these metals afterwards does not in any way interfere with this effect, showing, no doubt, that this acid has been absorbed by these metals and is retained very obstinately.

The graphite I used was of course purified both from iron and manganese before being worked with.

In reference to the chemical action of substances upon which oxygen has been in some way condensed, I may perhaps be allowed to state further that when graphite, which has been exposed to the air, is voltaically connected in sea water with graphite just recently ignited, electric

* Read before the Wellington Philosophical Society, January 29, 1876.

currents are generated; graphite which has been desulphurised also generates electric currents when connected in this manner with any negative conducting sulphide in a solution of an alkaline sulphuret. By the use of currents generated in this manner I have even electrolyted copper from its sulphate.

I forbear making any specific deductions from the results above related until I can supplement them in such a way as will enable me to discriminate, with greater surety than I at present can, the exact nature of the absorptive process by which graphite and platinum become chemically active in the way these results indicate.

NOTICES OF BOOKS.

The Textile Colourist, a Monthly Journal of Bleaching, Printing, Dyeing, and Finishing Textile Fabrics. Edited by C. O'Neill, F.C.S. Vol. iii. Manchester: Palmer and Howe. London: Simpkin and Marshal.

The present volume of the *Textile Colourist* contains a large amount of valuable matter. The "History of Textile Colouring"—a department which the Editor appears to have studied with much care—is continued, and brings to light not a few interesting facts. Thus in a book on bleaching, published by a Dr. Home more than a hundred and twenty years ago, we find the first steps towards a volumetrical analysis of alkaline ashes. The standard acid employed was a mixture of 1 part of spirit of nitre with 6 parts of water, and "the estimation was by the number of tea-spoonfuls of acid required to finish the effervescence of a given weight of ashes." Still, as Mr. O'Neill adds, "the principle was there." The same Dr. Home expresses also very advanced views on the benefits to be derived from the mutual interchange of knowledge among practical men. Says he—"There is nothing promotes an art faster than the communication of those who practise it; nothing retards it more than a selfish spirit of keeping all a secret." To this passage and to Mr. O'Neill's comments thereon we must express our hearty assent.

There are here, also, some useful extracts from De Vinant's work on dyeing, printing, and bleaching; from Kœppelin, on silk-printing; and from Depierre's treatise on the washing-machines used in the tinctorial arts. There are "Notes from Mulhouse," containing a summary of novelties from that important focus of dyeing and printing. We find it here mentioned that the very minute traces of vanadium which M. Witz stated as sufficient for the development of aniline-black have in other hands required augmenting to four or ten times the amount. The discovery of vanadiferous minerals, such as Roscoelite, is therefore highly opportune. It is also reported that the steel doctors are attacked by the vanadium colour, though to a less extent than by the copper sulphide. There are also notes from the rival industrial society, that of Rouen, which is displaying an admirable amount of activity. We regret, however, to find that the English contributions to the arts of dyeing and printing bear so small a proportion to those derived from abroad. Whether our industrial leaders are resting on their oars, or whether each man carefully keeps to himself the improvements he effects, and prefers the protection of secrecy to that of the patent office, we are unable to decide. In this case we hope they will take to heart Mr. O'Neill's exhortation on p. 74.

The *Textile Colourist* is taking its full share in the great war against the jog-trot, rule-of-thumb spirit which still haunts so many of our manufacturers, and we therefore wish it success.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 2, July 9, 1877.

Alcoholate of Chloral.—E. Wurtz.—The ebullition point of this compound is higher than that of the hydrate, which would be an anomaly in case of compounds capable of boiling without decomposition. Its vapour-density, like that of the hydrate, answers to 4 volumes. The dehydration of crystalline oxalate of potassa takes place as readily in the vapour of chloral alcoholate as in the air. This is not the case with the hydrate.

On Electric Transmission through the Soil by the Intervention of Trees.—Th. du Moncel.—The author draws the following conclusions from his experiments:—Trees are all more or less conductors, and their conductivity depends on the quantity of liquid which they contain. The roots of a tree play the part of electrodes, and their efficacy as agents of transmission is in relation with the conductivity of the tree and with their development. The resistance of a tree setting out with the leaves—and supposing contact only made with a few of them—varies, in round numbers, from 2 to 400,000 kiloms. of telegraphic wire; that of the trunk, at the height of 7 to 8 metres, does not greatly exceed, with the intervention of the soil, 3000 kiloms. There is consequently no great reason to be afraid of the contact of telegraphic wires with the leaves of trees.

Diamagnetism of Condensed Hydrogen.—R. Blondlot.—Graham had found hydrogenium-palladium more magnetic than palladium. Wiedemann ascribes this result to iron present as an impurity in Graham's palladium and reduced by the hydrogen. Blondlot agrees with Wiedemann, and finds that condensed hydrogen is powerfully diamagnetic.

Photometric Researches on Coloured Flames.—M. Gouy.—Not suitable for abstraction.

On a New Metal, Davyum.—Sergius Kern.—Described in an original paper by the author.

Oxidisability of Manganic Sulphide.—Ph. de Clermont and H. Guiot.—A quantity of the flesh-coloured sulphide is carefully washed with pure water on a filter; the filter is rapidly pressed between folds of blotting-paper and placed in a vacuum over concentrated sulphuric acid. After three days it is taken out of the vacuum and exposed to the air, when it immediately takes fire, giving off sulphurous acid and leaving sulphate and brown oxide of manganese.

On a New General Method for the Synthesis of Hydrocarbons, Acetones, &c.—C. Friedel and J. M. Crafts.—The chloride of zinc and the ferric and ferrous chlorides are capable of acting similarly to the chloride of aluminium.

Action of Bromine on Pyro-tartaric Acid.—E. Bourgoin.—On heating to 120° 10 parts of pyro-tartaric acid with 24 of bromine and 10 of water, Lagermark obtained bromoform, bromoxaform, bromo-citraconic anhydride, an oily product of a tar-like odour, and a colourless acid not yet isolated. The author, on repeating his experiment, obtains only a single crystalline body having the composition and properties of Kekulé's bromo-citraconic anhydride.

Determination of Carbonic Acid in Blood Serum.—L. Fredericq.—The author defends his method against the strictures of MM. Mathieu and Urbain.

Researches on Bitter Almonds.—M. Portes.—investigation on the origin and locality of amygdalin bitter almonds.

Nickeliferous Iron of Santa Catarina (Brazil).—M. Luna y.—An account of a meteorite originally weighing about 7000 kilos., and containing from 7·8 to 34·6 per cent of nickel.

Comparative Study of Cupreous Compounds introduced into the Stomach and the Blood.—V. Feltz and E. Ritter.—Insoluble albuminate of copper introduced into the stomach has scarcely any effect on the system. The soluble albuminate occasions affections fully as severe as those produced by the ammoniacal sulphate in distilled water. Sulphate of copper dissolved in syrupy glycerin is much more poisonous than the same salt dissolved in aqueous glycerin. A solution of albuminate of copper containing 0·00115 grm. of copper per c.c. occasions death as soon as the dose introduced exceeds 0·0015 grm. per kilo. of the weight of the animal. A salt of copper introduced into the stomach does not become poisonous until the system has absorbed the quantity just mentioned as proving fatal in the blood. The chief channels for the elimination of copper, placed in the order of their importance, are the bowels, the liver, and the kidneys.

Detection of Salicylic Acid.—H. Martz.—The author points out that Robinet's method for the detection of this acid in wines and urine is erroneous. He considers it preferable to agitate with a few c.c. of ether previously acidulated with hydrochloric acid, and allow the ethereal solution to evaporate spontaneously, whilst floating upon a weak solution of ferric chloride, when it produces an intense violet-coloured ring.

No. 3, July 16, 1877.

Carbuncle and Septicæmia.—MM. Pasteur and Joubert.—The authors contend, in opposition to M. Paul Bert, that the sole cause of carbuncle is a microscopic organism—the Bacteridia.

Experiments according to which the Fragmentary Form of Meteoric Irons may be ascribed to a Fracture produced by Strongly-compressed Gases, such as those Generated by the Explosion of Dynamite.—M. Daubrée.—This paper cannot be satisfactorily abstracted without the insertion of the illustrations, but its nature appears sufficiently from the title.

Researches on the Compressibility of Liquids (Continuation).—E. H. Amagat.—The compressibility of the successive terms of the family of formenic carbides decreases regularly as we descend in the series, both at 100° and at common temperatures. Benzol is much less compressible than amylen hydride, which contains the same number of equivalents of carbon. In the series of alcohols, and in that of their acetates, the ratio of these variations, which is inversely as that of the densities, may differ according to temperature, and at an elevated temperature tends to become the same as in the series of carbonates. The presence of sulphur, chlorine, and bromine in liquids tends to render them less compressible. If we compare the compressibility of amylen hydride with those of common ether and of hydrochloric ether, we may conclude that very probably the first terms of the series of formenic carbides are bodies endowed with the greatest compressibility in the liquid state.

Electric and Capillary Properties of Mercury in contact with Different Aqueous Solutions.—M. Lippmann.—The author's experiments lead to this conclusion:—For each value of the electromotive force the capillary constant has a single determined value independent of the chemical composition of the liquid. In other words, if for two different compounds the electromotive force is the same, the capillary constant is the same likewise.

Vapours of the Chloral Alcoholates.—L. Troost.—The author finds that the densities of the vapours of the ethylate, methylate, and amylate of chloral, like that of the hydrate, correspond to 8 volumes.

Action of Light upon Hydriodic Acid.—G. Lemoine.—Hydrogen and oxygen do not combine sensibly in the cold under the influence of light. Dry gaseous hydriodic acid, if pure and not mixed with air, may be preserved in absolute darkness for more than a year. As soon as light is admitted decomposition begins, as is shown by the deposition of solid iodine, but the process is very slow even in full sunlight. This reaction is null between the red and the green rays, but is effected in the violet and the blue. The result of four days' exposure to the sun, as found by determining the hydrogen set free, was—

	Approximate Thickness	Hydriodic Acid Decomposed.
White glass	0·5 m.m.	0·08
Red ,,	0·5 ,,	0·00
Green ,,	0·8 ,,	0·00
Blue ,,	0·9 ,,	0·04
Violet ,,	1·3 ,,	0·01

The slow decomposition of gaseous hydriodic acid by light may serve in great meteorological observations to measure the degree of illumination of the heavens. The aqueous solution of hydriodic acid, whether dilute or concentrated, is not affected by light. Such solutions, however, as well as the gaseous acid, are decomposed by the oxygen of the air, even in the dark.

On a New Derivative of Indigotin.—P. Schutzenberger.—The following results have been obtained with pure indigotin, prepared by agitating an alkaline solution of white indigo in contact with air:—It was then heated in a closed vessel to 180° C., with twice its weight of the crystallised hydrate of baryta, 1½ times its weight of powdered zinc, and ten times its weight of water, for forty-eight hours. At the outset there was formed an alkaline solution of white indigo, a true vat; but after two days of heating the liquid on exposure to the air ceased to yield blue indigotin. At the bottom of the autoclave was found an insoluble powder, chiefly mineral, and consisting of zincate of baryta, carbonate of baryta, and zinc in powder. This residue yields to alcohol an organic substance which gives a brown colour to the solvent. On evaporation to dryness this alcoholic solution leaves an amorphous resinous residue of a deep colour, brittle in the cold, but becoming soft under 100°. This residue was mixed with zinc powder, and the mixture heated by portions of 10 grms. in a small porcelain crucible, set in a sand-bath and heated by a Bunsen burner. The crucible was covered with filter-paper, upon which rested the lid. The interior of the crucible then became lined with long and beautiful crystalline needles of a light yellow, resembling sublimed anthraquinon. They are fusible at 245°, insoluble in water, soluble in ether and alcohol, to which they communicate a bluish fluorescence. On analysis they give numbers agreeing exactly with a polymer of indol, $x(C_8H_7N)$. The new body has well-defined basic properties, and forms crystalline compounds with acids. The author has given it the name indolin. It dissolves in hot dilute hydrochloric acid, and the solution forms with platinic chloride a yellow, granular, crystalline precipitate. Concentrated sulphuric acid dissolves indolin with a blue fluorescence, and the solution on exposure to the air deposits—as it becomes hydrated—yellow crystalline grains of indolin sulphate. Indolin sublimes sometimes in needles resembling anthraquinon, sometimes in leaflets like anthracen, but always leaving a carbonaceous residue.

Properties of Resorcin: a Thermo-Chemical Investigation.—L. Calderon.—The author finds that resorcin behaves like a diatomic phenol.

Reform of Certain Analytical Procedures used in the Laboratories of Agricultural Stations and of Chemico-Meteorological Observatories. (Second Memoir, Acidimetry.)—A. Houzeau.—Reserved for insertion in full.

Nature of the Acids contained in the Gastric Juice.—C. Richet.—The organic acid soluble in ether and contained in the gastric juice is the sarcolactic.

Experiments proving that neither Air nor Pure Oxygen, when Compressed, are able to Destroy the Septicity of Putrid Blood.—V. Feltz.—Putrid blood loses nothing of its septicity by prolonged contact with air or oxygen at a high tension. The compressed air has no action upon the organised ferments whose existence in putrid blood is demonstrated by the microscope. Pure oxygen, at very high and prolonged pressures, destroys the vibriones, but has no action on the coccco-bacteria. Its influence is very similar to the desiccation of putrid blood by exposure to the sun. It is impossible by this method of experimentation to separate in putrid blood organised ferments from diastasic ferments.

Bulletin de la Societe Chimique de Paris,
No. 9, May 5, 1877.

Reduction of Aniline-Black, and its Conversion into a Rose Colouring Matter.—M. Goppelsrœder.—Already noticed.

Transformation of Ordinary Pyro-tartaric Acid into the Hydrobromate of Tribromated Ethylen.—M. E. Bourgoin.—Already noticed.

Note on the Determination of the Sugars and of the Acidity in Forty-three Varieties of Apples.—M. A. Truelle.—The author describes his mode of procedure at length, and gives the results in the form of a table. In all the apples examined inverted sugar and cane-sugar were present in mixture, but in very different proportions. The White Calville contains 6·377 per cent of inverted sugar to 5·600 of cane-sugar. In the Grey Fenouillet we have 13·386 per cent of inverted sugar, and merely 0·839 of cane-sugar. The largest total percentage of sugar, 14·440 per cent, occurred in the Red American Rennet; smallest amount, 7·280 per cent, in the Pomme d'Eve. The highest acidity, equal 2·274 per cent of SO_4H, was in the Calville de Maussion; in no other variety did the acid reach 1 per cent, and in the Grey Fenouillet it was found =0.

Derivatives of Dinitrated Naphthalin, Alpha and Beta.—M. A. Atterberg.

Consitution of the Alpha Derivatives of Naphthalin.—M. A. Atterberg.—These papers are not adapted for useful abstraction.

A number of papers on organic chemistry, given in abstract, are taken from *Liebig's Annalen* and from *Ber. der Deutsche Chem. Gesell.*, and have been, or will be, duly noticed under those heads.

Aniline-Bronze.—O. Fiorillo.—In 100 grms. of alcohol at 95 per cent, heated in the water-bath, are dissolved 10 grms. of rosein and 5 grms. of methyl-violet; 5 grms. of benzoic acid are then added, and the whole is allowed to boil for some minutes until the green colour of the mixture has changed to a golden bronze. The colour produced is brilliant and solid. It adheres easily to paper, paper-pulp, wood, glass, leather, &c., and is applied with a brush.—*Dingler's Polytechnisches Journal*, ccxxi., 487.

Thao, a New Material for Dressing Textile Goods.—Thao is the gelatinous part of certain algæ employed in Cochin China. Its utilisation extends to various manufactures, and its chief future seems to be in finishing stuffs. It may be extracted from certain sea-weeds from the coast of Bretagne. It has been said to be difficult of solution, and to be contaminated with a yellow colouring matter. If previously macerated for about twelve hours, thao may be dissolved in boiling water in ten to fifteen minutes. The solution, if strained and stirred till completely cold, does not congeal into a jelly, but remains fluid, and can thus be applied cold without injuring the colours of the stuffs. The yellow principle is eliminated by prolonged boiling, and is deposited in an insoluble crust on the sides of the pan. As thao dissolves only with the aid of heat, goods saturated with it are not affected by moisture. The solutions of thao do not turn mouldy, and have no action upon the solution of permanganate. It may also be employed in the manufacture of gold-beaters' skin.—*Moniteur de la Teinture.*

Removing Oil from Woollen and Cotton Waste.—This process, patented in Germany, consists in mixing the waste in a drum with plaster of Paris. When the plaster, after a prolonged contact, has absorbed the fatty matter, the mixture is transferred to another drum pierced with holes, through which the bulk of the plaster escapes. The rest is removed by beating.

Reagent for Wool and Cotton in Mixed Fibres and Tissues.—E. Liebermann.—The reagent is magenta mixed with an alkali so as to liberate its colourless base. The thread or stuff is plunged into the clear liqnid, and then washed in water. The red colour of magenta reappears, on exposure to air, upon the woollen fibres, whilst the cotton remains colourless and readily distinguishable. The direct use of a coloured solution of magenta does not gives results equally distinct.

The Temperature and the Composition of the Gases of Ultramarine-Furnaces.—F. Fischer.—The temperature necessary for the production of ultramarine is about 700°. The great dilution of the sulphurous acid gas given off, and the irregularity of its evolution, prevent its utilisation in the lead chambers. Carbonic oxide is only exceptionally present.—*Dingler's Polytechnisches Journal*, ccxxi., 468.

Gilding and Silvering Glass and Porcelain.—E. Hansen.—Sulphur is dissolved in the essential oil of lavender to a semi-fluid consistence. With this is mixed an ethereal solution of the chloride of gold or of platinum, and the whole is concentrated anew at a gentle heat. The composition thus obtained is applied with a pencil to the surfaces to be metallised, after which they are placed in the muffle, and carefully heated till the sulphur and other volatile matters are expelled. There is formed thus a deposit of gold or of platinum, which may receive a uniform layer of silver, gold, or platinum by the galvanic method.—*Polytech. Notizblatt.*

Aniline-Black Incapable of Turning Green.—C. F. Brandt.—To prevent the "greening" of aniline-blacks it is sufficient to pass the dyed pieces through a weak solution of aniline-violet. For printed goods, the white grounds are cleared with chlorine and a boiling soap-bath. The black thus treated does not turn green, even after immersion in a solution of sulphurous acid.—*Moniteur de la Teinture* and *Bull. de la Soc. Ind. de Mulhouse.*

Solubility of Silk in an Alkalino-Glyceric Solution of Copper.—M. J. Lœwe. The solvent is prepared as follows:—Dissolve 10 grms. sulphate of copper (pure) in 140 to 160 c.c. of distilled water, add 8 to 10 grms. of glycerin at 1·24 specific gravity, drop in caustic soda until the precipitate of hydrate of copper is re-dissolved, and then filter. An excess of soda should be avoided. This liquid dissolves silk more or less rapidly according to the degree of concentration, but has no such action upon cotton, linen, or wool. Silks dyed black with salts of iron should be previously digested in an alkaline sulphide, and the sulphide of iron formed removed by the subsequent application of weak hydrochloric acid. Other dyes do not retard the process of solution. Wool is coloured black by the alkalino-glyceric solution of copper, but this colouration is easily removed by an acid bath.—*Dingler's Polytech. Journal.*

Justus Liebig's Annalen der Chemie,
Band 187, May 12, 1877.

Communications from the Laboratory of the University of Würzburg.—These consist of a paper on Benzoyl-acetic-ester, $C_{13}H_4O_4$, by Julius Bonné; a memoir on Benzyl-acetic-ester, $C_{13}H_{16}O_3$, by F. L. Ehrlich; and a paper on Allyl-acetic-ester, $C_9H_{14}O_3$, by F. Zeidler.

On a Problem of Dissociation.—A. Horstmann.—When a solid body is dissociated into gaseous constituents the process is externally very similar to evaporation, from which it is, however, distinguished by the fact that the pressure which can arrest and even reverse dissociation is not exerted by a single gas, but by a gaseous mixture. This leads to the author's problem. If such a gaseous mixture is formed by decomposition in a vacuum—the ordinary case when vapour tension is to be measured—the constituents are always mixed in one and the same proportion, as they form the solid body. But what happens if one of the constituents is in excess? Taking as an example carbamate of ammonia, which is dissociated into 1 mol. CO_2 and 2 mols. NH_3. If it is formed or decomposed in an atmosphere of excessive carbonic acid (or of ammonia), will the maximum tension of dissociation, which in this case sets a limit to the formation or dissociation, be the same as in a vacuum or not? In other words, will the separate pressure of the free ammonia be the same in an excess of carbonic acid as in a properly composed gaseous mixture? The author, by a series of experiments, has shown that without exception the vapour-tension is greater in presence of ammonia or carbonic acid than in a vacuum, and that the vapour-tension of carbamate of ammonia is always greater in carbonic acid than in ammonia of equal density.

On Meta-methol-camphor.—P. Perrenoud.—In this paper the author describes the preparation of meta-nethol-camphor by the action of melting chloride of zinc—the method to which he gives the preference; the formation of meta-nethol-sulpho-camphoric acid, with its calcium and barium salts; and of meta-nethol-sulpho-camphoric chloride. He also describes a modification of V. Meyer's method of determining vapour-densities at low temperatures.

Researches on Certain Urinary Deposits (Communicated by B. Tollens).—These researches consist of a paper on "Phosphatic Sediments in Alkaline Urine," by C. Stein; and "Contributions to the Knowledge of Cistinuria in Man," by A. Niemann.

On Thio-glycollic Acid.—Peter Claesson.—The author finds that the mono-sulpho-glycollic acid is not pure thio-glycollic acid, but a mixture. He has examined several of its derivatives, such as hydrargyro-thio-glycollic acid, cuprosum-thio-glycollic, and similar compounds into which other metals enter.

On Normal Hexylic Alcohol and Normal Œnanthylic Acid.—A. Lieber and G. Janecek.—The authors conclude that the capronic acid formed by fermentation along with butyric acid is identical with the synthetic normal acid of Lieben and Rossi, and with the capronic acid obtained by Franchimont and Zincke by the oxidation of hexylic alcohol prepared from the oil of heracleum.

Reimann's Färber Zeitung,
No. 26, 1877.

This issue contains a sketch of the history of calico-printing in India, its original home, and also a continuation of the charges of piracy brought against a certain Belgian paper.

No. 27, 1877.

This issue is chiefly devoted to the proposed School of Tinctorial Art in Berlin.

Moniteur Scientifique, Quesneville.
May, 1877.

Certain Little-known Causes of the Deterioration of Steam-boilers.—In contact with certain kinds of water fatty matters intoduced into a boiler may become a grave source of danger. Even the purest distilled water without the presence of grease cannot be recommended: it attacks the iron and produces a rapid deterioration, whilst waters slightly calcareous leave the metal absolutely unattacked. The subject requires the careful attention of chemists.

Contribution to the Knowledge of the Alkaloids of Cinchona.—J. E. de Vry.

On Cinchonidin.—L. Pasteur.

Sulphate of Cinchonidin.—L. Pasteur.

Contributions to the History of Conquinon.—O. Hesse.

These important chemico-pharmaceutical papers do not admit of abstraction.

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BRITISH ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE.

PLYMOUTH MEETING, AUGUST 15, 1877.

INAUGURAL ADDRESS OF THE PRESIDENT,

PROFESSOR ALLEN THOMSON, M.D., LL.D., F.R.S., F.R.S.E.

AFTER the long interval of six and thirty years the British Association for the Advancement of Science holds its annual meeting, the forty-seventh since its foundation, in this beautiful and interesting locality; and, strangely enough, on this occasion as on the former, it passes from Glasgow to Plymouth. We are delighted to be assembled here, and are even surprised that the Association has been able so long to resist the power of attraction by which it has been gravitating towards this place. While we are prepared to be charmed with the surpassing beauty of its scenery, and know the deep interest of its pre-historic vestiges, its historic memories, and its artistic associations, we have been frequently reminded of its scientific vigilance by the records of its active scientific work; and we are now ready and anxious to witness all we can behold of its energy and success in the application of scientific discovery to the practical arts. Should we, as might be expected in a place hitherto so famous in its relations to our naval and military history, find most prominent those relating to the mechanism of war, we shall still hope that the effect of greater perfection in the engines of destruction may only be the means of rendering peace more permanent and secure.

It is a source of regret to myself, and may be, I fear, a cause of detriment to this Meeting, that the choice of a President should have fallen upon one whose constant occupation with very special branches of science has fitted him so inadequately for the distinguished position to which he has been called. I can only derive comfort from knowing that, wherever it may be necessary, there are many others present most able to supply what may be wanting on my part; and I must therefore at once bespeak their assistance and your indulgence.

I have selected for the subject of the remarks which I am about to offer for your acceptance a biological topic, namely, the "Development of the Forms of Animal Life," with which my studies have been occupied, and which has important bearings on some of the more interesting biological questions now agitating the scientific world. But before proceeding with the discussion of my special subject, it is my desire to call your attention shortly to the remarkable change in the manner of viewing biological questions which has taken place in this country during the last half-century—a change so great, indeed, that it can scarcely be fully appreciated except by those who have lived through the period of its occurrence.

In the three earlier decades of this century it was the common belief, in this country at least, shared by men of science as well as by the larger body of persons who had given no special attention to the subject, that the various forms of plants and animals recognised by naturalists in their systematic arrangements of genera and species were permanently fixed and unalterable, that they were not subject to greater changes than might occur as occasional variations, and that such was the tendency to the maintenance of uniformity in their specific characters that, when varieties did arise, there was a natural disposition to the return, in the course of succeeding generations, to the fixed form and nature supposed to belong to the parental stock; and it was also a necessary part of this view of the permanency of species that each was considered to have been originally produced from an individual having the exact form which its descendants ever afterwards retained. To this scientific dogma was further added the quasi-religious view that in the exercise of infinite wisdom and goodness, the Creator, when He called the successive species of plants and animals into existence, conferred upon each precisely the organisation and the properties adapting it best for the kind of life for which it was designed in the general scheme of creation. This was the older doctrine of "Direct Creation," of "Teleological Relation," and of "Final Causes;" and those only who have known the firm hold which such views had over the public mind in past times can understand the almost unqualified approbation with which the reasoning on these questions, in writings like the "Bridgewater Treatise" (not to mention older books on Natural Theology), were received in their time, as well as the very opposite feelings excited by every work which presented a different view of the plan of creation.

On the Continent of Europe, it is true, some bold speculators, such as Goethe, Oken, Lamarck, and Geoffroy St.-Hilaire, had, in the end of the last and commencement of this century, broached the doctrine that there is in living beings a continuous series of gradations as well as a consistent and general plan of organisation, and that the creation, therefore, or origin of the different forms of plants and animals must have been the result of a gradual process of development or of derivation one from another, the whole standing connected together in certain causal relations. But in Britain such views, though known and not altogether repulsive to a few, obtained little favour, and, by some strange process of reasoning, were looked upon by the great majority as little short of impious questionings of the supreme power of the Almighty.

How different is the position of matters in this respect in our day!—when the cautious naturalist receives and adopts with the greatest reserve the statement of fixed and permanent specific characters as belonging to the different forms of organised beings, and is fully persuaded of the constant tendency to variation which all species show even in the present condition of the earth, and of the still greater liability to change which must have existed in the earlier periods of its formation; when the belief prevails that, so far from being the direct product of distinct acts of creation, the various forms of plants and animals have been gradually evolved in a slow gradation of increasing complexity; and when it is recognised by a large majority of naturalists that the explanation of this wonderful relation of connexion between previously existing and later forms is to be found in the constant tendency to variation during development and growth, and the perpetuation of such variations by hereditary transmission through successive generations in the long but incalculable lapse of the earth's natural mutations. These, as you must all be aware, are in their essential features the views now known as Darwinism, which were first simultaneously brought forward by Wallace and Darwin in 1858, and which, after being more fully elaborated in the works of the latter and ably supported by the former, secured, in the incredibly short space of ten or twelve years, the general approval of a large portion of the scientific world. The change of opinion is, in fact, now such that there are few scientific works on Natural History, whether of a special or more general character, in which the relation which the facts of science bear to the newer doctrines is not carefully pointed out; that, with the general public too, the words "Evolution" and "Development" have ceased to excite the feelings, amounting almost to horror, which they at first produced

in the minds of those to whom they were equally unfamiliar and suspicious; and that, even in popular literature and ephemeral effusions, direct or metaphorical illustrations are drawn in such terms of Darwinian theory as "struggle for existence," "natural selection," "survival of the fittest," "heredity," "atavism," and the like.

It cannot be doubted that in this country, as on the Continent, the influence of authority had much to do with the persistence of the older teleological views; and, as has been well remarked by Haeckel, one of the ablest and keenest supporters of the modern doctrine, the combined influence more especially of the opinions held by three of the greatest naturalists and biologists who have ever lived, viz., Linnæus, Haller, and Cuvier (men unsurpassed in the learning of their time, and the authors of important discoveries in a wide range of biological science), was decidedly adverse to the free current of speculative thought upon the more general doctrines of biology. And if it were warrantable to attribute so great a change of opinion as that to which I have adverted as occurring in my own time to the influence of any single intellect, it must be admitted that it is justly due to the vast range and accuracy of his knowledge of scientific facts, the quick appreciation of their mutual inter-dependence, and, above all, the unexampled clearness and candour in statement of Charles Darwin.

But while we readily acknowledge the large share which Darwin has had in guiding scientific thought into the newer tracks of biological doctrine, we shall also be disposed to allow that the slow and difficult process of emancipation from the thraldom of dogmatic opinion in regard to a system of creation, and the adoption of large and independent views more consistent with observation, reason, philosophy, and religion, has only been possible under the effect of the general progress of scientific knowledge and the acquisition of sounder methods of applying its principles to the explanation of natural phenomena.

I have already referred to Goethe, Oken, Lamarck, and Geoffroy St.-Hilaire as among the most prominent of the earlier pioneers in the modern or reformed conceptions of biological laws. But were it desirable to mark the progress of opinion by quoting other authors and labourers whose contributions have mainly supplied the materials out of which the new fabric has been constructed, I should have to produce a long catalogue of distinguished names, among which would be found those of Lyell and Owen, as earliest shaping the doctrines and guiding opinion in this country, Johannes Müller and Von Baer, as taking the places of Haller and Cuvier on the Continent, and a host of other faithful workers in Biology belonging to the earlier part of this century, such as those of G. Treviranus, J. F. Meckel, Carus, and many more.* To Huxley more especially and Herbert Spencer the greatest influence on British thought in the same direction is to be ascribed.

Let us hope that in these times, when it has been found necessary to modify the older teleological views to so great an extent, although there may still be much that is unknown, and wide differences of opinion in regard to the nature and sequence of natural phenomena and the mode of their interpretation, all naturalists will now concur in one important principle, viz., that truthful observation and candid judgment must alone be our guides in the interpretation of Nature, and that that theory of Creation is most deserving of our adoption which is most consistent with the whole body of facts carefully observed and compared.

To attempt to trace, within the limits to which my remarks must be confined, the influence which the progress of knowledge has exercised upon the scientific and general conception of biological doctrines would be impossible, for the modification of opinion on these subjects has proceeded not less from the rapid advance which our age has witnessed in the progress of general science, especially o physics and chemistry, than from that of departments belonging to biology itself.

Thus, to go no further than the most general laws of Nature, the whole doctrine of the conservation and transmutation of force in physics, so ably expounded to this Association by Mr. Justice Grove, the theory of compound radicals and substitution, with the discovery of organic synthesis, in chemistry, and the more recent advance in speculation with regard to the molecular constitution and properties of matter, with which we must associate the names of our last President and of Clerk Maxwell, in completely changing the aspect of physical and chemical sciences within the last thirty-five years, have paved the way for views of the constitution and action of organised bodies very different from those which could be formed at the time of the first Meeting of the Association in this place. And if, confining ourselves to the department of Biology, we add the discovery by microscopical observation of the minuter elementary forms of organisation, more especially as flowing from the comprehensive views of organised structure promulgated by Schleiden and Schwann nearly forty years ago, the later discovery and investigation of living protoplasmic substances, the accumulated evidence of progressive types of animal and vegetable forms in the succession of superimposed strata composing the crust of the earth, the recent discoveries as to the conditions of life at great depths in the ocean, the vast body of knowledge brought together by the labours of anatomists and physiologists as to the structure and functions of almost every plant and animal, and (still more, perhaps, than any other single branch of biological inquiry) if we note the rapid and immense progress which has been made during the last fifty years in the study of the entirely modern science of the development of living beings, we shall be able to form some conception of the enormous extension in our time of the basis of observation and fact from which biological phenomena may now be surveyed, and from which just views may be formed as to their mutual relations and general nature.

It is now familiarly known that almost all (if not, indeed, all) the plants and animals existing on the earth's surface derive their origin from parents or previously existing beings whose form and nature they closely reproduce in their life's history. By far the greater number spring from germs in the form of visible and known spores, seeds, or eggs; a few may be traced to germs, or to vestiges of the parental body, the exact nature of which may be doubtful; and some, including even a certain number of those also produced from known germs, are either constantly or occasionally multiplied by budding, or by a process of cleavage or direct and visible division of the parent body.

The germ constituting the basis of new formation, whether it have the form of spore, seed, or ovum, is of the simplest kind of organisation, and the process by which a new plant or animal is produced is necessarily one of gradual change and of advance from a simpler to a more complex form and structure: it is one of "evolution," or, as I would rather name it, "development." But before proceeding to discuss the subject of development in the higher animals, it is right to advert to the preliminary and often-debated question, which naturally presents itself, viz., "Do all living or organised beings, without exception, spring from germs, or from any kind of organised matter that has belonged to parents? or may there not be some, especially among the simpler forms (with regard, indeed, to which alone there has of late been any question), which are produced by the direct combination of their component elements, in the way of the so-called

* It would also be unjust to omit to mention here one of the earliest attempts to bring British opinion into a new channel, by the remarkable work entitled "Vestiges of Creation," which appeared in 1844, nor to conceal from ourselves the unmerited ridicule and obloquy attempted to be thrown upon the author, not perhaps so much on account of the many inaccuracies unavoidable in an attempt at the time to overtake so large a field, as directed against the dangerous tendencies supposed to lurk in its reasoning.

spontaneous or equivocal generation, heterogenesis or abiogenesis?

The importance of the right solution of this problem is not confined merely to the discovery of the mode of origin of the lowly organisms which have been the more immediate object of investigation by naturalists in recent times, but is one of much wider significance, seeing that, if it shall be satisfactorily proved, or even rendered probable, that in the course of cosmical development all the various kinds of plants and animals have been gradually produced by evolution out of pre-existing simpler forms, and thus the whole series of organised beings in Nature has been shown to be one of hereditary connexion and derivation, then it would follow that the history of the origin of the simplest organisms may be the key to that of the first commencement of life upon the earth's surface, and the explanation of the relation in which the whole succeeding progenies stand to their parental stocks.

From the very lucid and masterly view of this subject given by Prof. Huxley in his Address to the Association at Liverpool, so recently as in 1870, in which the conclusion he formed was based very much on the exhaustive and admirable researches of Pasteur, I might almost have dispensed with making further reference to it now, but for the very confident statements since made by the supporters of the doctrine of abiogenesis, among whom Dr. Bastian stands most prominent in this country, and for the circumstance that the life-history of many of the lower organisms was still imperfectly known.

During the last seven or eight years, however, renewed investigations by most competent inquirers have followed one another in quick succession, from a review of which we cannot but arrive at a conclusion adverse to the theory of heterogenesis, viz., that no development of organisms, even of the most simple kind, has been satisfactorily observed to occur in circumstances which entirely excluded the possibility of their being descended from germs, or equivalent formative particles, belonging to pre-existing bodies of a similar kind. I can do no more now than name the authors of the most conclusive experiments on this subject, which I do nearly in the order of the publication of their researches, as those of Mr. W. N. Hartley in 1872, Messrs. Pode and Ray Lankester in 1873, Dr. Burdon Sanderson in that and the following years, Dr. W. Roberts in 1874, Prof. Lister in 1875, and most recently of Prof. Tyndall, Prof. Cohn, and of Messrs. Dallinger and Drysdale.*

But, admitting that the evidence from direct experiment is such as entirely to shut us out from entertaining the view that spontaneous generation occurs in the present condition of the earth, we are not relieved from the difficulty of explaining how living organisms or their germs first made their appearance, nor are we debarred from attempting to form hypotheses as to how this may have taken place. First, upon the theory of Evolution, which, strictly carried out, supposes the more complex organisms to be derived from the more simple, it might be held that the conditions affecting the combination of the primary elements of matter into organic forms may at one time have been different from those which now prevail, and that, under those different conditions, abiogenesis may have been possible, and may have operated to lay the foundations of organic life in the simpler forms in which it at first appeared—a state of things which can only be vaguely surmised, but in regard to which no exact information can be obtained. Or, secondly, evading the difficulty of strict cosmical evolution, we might suppose that vital conditions may have been coeval with the first existence of physical and chemical properties in the rest of natural bodies. But this hypothesis would be exposed to the objection that, according to the cosmical view generally held by physicists, the whole materials composing the earth have originally been subjected to incandescent heat. Nor is the difficulty abolished, but only removed to a more remote period, by the supposition of the transport of germs from another planet or their introduction by means of meteorites or meteoric dust; for, besides the objection arising from the circumstance that these bodies must have been subjected to a very high temperature, we should still have everything to learn as to the way in which the germs arose in the far distant regions of space from which they have been conveyed.

The incompleteness of the geological record leaves us in the dark as to the time at which the first dawnings of life appeared in the lower strata of the earth's surface. The most recent researches tend to carry the origin of life back to a much earlier period than was at one time believed, and (if the famous *Eozoon* be admitted as evidence) even into that of the Laurentian strata. But even if doubts should prevail with regard to the presence of definite organised forms in the older sedimentary strata, the occurrence in them of carbon in the form of graphite in large quantities makes the previous existence of living organisms at least possible, and it may be that the complete metamorphosis which these rocks have undergone has entirely removed all definite traces of organisation.

Nor have we the means from geological data of determining whether the beings of the vegetable or of the animal kingdom first made their appearance. If we adopt the view which has for some time been entertained by physiologists, that animals are entirely dependent, directly or indirectly, on plants for the material which constitutes their living substance, and that plants, as constructive agents, alone have the power to bring together the elements of lifeless matter, from such states as carbonic acid, water, and ammonia, into the condition of the living solid, the inference would be inevitable, at least for the great majority of the animal creation, that they must have been preceded by plants. But palæontology is as yet silent on this interesting question; and, if we consider the remarkable approach which is made in structure and properties between the lowest and simplest members of the two kingdoms of organic nature, so that at last all distinction between them seems entirely to vanish, and a set of organisms is found which partake equally of animal and vegetable characters, or, rather, exhibit properties which are common to them both, we shall hesitate to postulate confidently for the primitive antecedence of vegetable life, although, perhaps, in later epochs the pre-existence of vegetables may be looked upon as necessary to the life of more developed animal organisms.

The reflection forces itself upon us that we are just as ignorant of the mode of first origin of all the compounds of the inorganic elements as we are of that of living matter; and we may therefore be excused if we suspend all theory and conjecture until we shall be guided to more reliable hypotheses through the plain track of observation and experiment.

The practical applications of the increased knowledge of the origin of minute animal and vegetable organisms are so numerous that it would occupy a much longer time

* I may refer to Dr. Bastian's paper in *Nature* of June 30, 1870, and to his two works, "The Origin of the Lowest Organisms" and "The Beginnings of Life," and papers to Roy. Soc., 1873. Mr. Hartley's researches, which were commenced in 1865, are described in a paper printed in the *Proceedings of the Royal Society* for 1872, and in his "Lectures on Air, 2nd edition, 1876, where an interesting account of the whole subject will be found. The experiments of Mr. Pode, of Oxford, and Prof. Ray Lankester are described in a paper on the "Development of Bacteria in Organic Infusions," in the *Proc. Roy. Soc.*, 1873, vol. xxi., p. 349. Dr. Burdon Sanderson's researches are contained in the "Reports of the Medical Officer of the Privy Council," and in various papers in *Nature*. Dr. W. Roberts's paper is printed in the *Transactions of the Royal Society* for 1874, vol. clxiv., p. 457. Prof. Lister's "Contribution to the Germ Theory of Putrefaction and other Fermentative Changes," &c., is contained in the *Transactions of the Royal Society of Edinburgh* for 1875, p. 315, and is also given in *Nature*. Prof. Tyndall's researches are described in his papers in the *Proceedings of the Royal Society* during the last two years. The work of Prof. Cohn, of Breslau, entitled "Beiträge zur Biologie der Pflanzen," 1873–76, contains many memoirs bearing upon this subject, which have been partly published in abstract in the *Microscopical Journal*, in which also will be found, in a series of contributions extending from 1873 to the present time, the interesting observations of Mr. W. H. Dallinger and Dr. J. Drysdale.

than is at my disposal to give any detailed account of them; but they are of such immense importance in their commercial, social, and sanitary relations that they ought never to be lost sight of.

It is now proved beyond doubt that the origin of putrefaction and fermentation is dependent on the presence in the substances which are the seat of change in these processes, or in the surrounding air, of the germs of minute organisms of an animal or vegetable nature, and that the maintenance of the chemical changes in which these processes mainly consist is coincident with and casually (if not essentially) dependent upon the growth and multiplication of these organisms.

Professor Lister had the merit of being the first to apply the germ theory of putrefaction to explain the formation of putrid matters in the living body; and he has founded on this theory the now well-known antiseptic treatment of wounds, the importance of which it would be difficult to over estimate.

The success or failure of plans for the preservation of meat and other articles of food without question depends on the possibility of the complete exclusion of the germs which are the cause of putrefaction and fermentation; and their management must therefore be founded on the most accurate knowledge of these organisms, and the circumstances influencing the persistence of their vitality and the vigour of their growth.

The theory of Biogenesis has also lately been the guide in the investigation of the causes of various forms of disease, both in the lower animals and in man, with the result of showing that in many of them the infective substance consists, in all probability, of germs of minute animal or vegetable organisms.

There is very great probability, indeed, that all the Zymotic diseases (by which we understand the various forms of fevers) have a similar origin. As has been well remarked by Baxter in an able paper on "The Action of Disinfectants," the analogies of action of contagia are similar to those of septic organisms, not to processes simply of oxidation or deoxidation. These organisms, studied in suitable fluids, multiply indefinitely when introduced in all but infinitesimal proportions. Thus they are, as near as we can perceive, the very essence of contagia.*

Leaving, however, these and many other general questions regarding the origin of the lowest forms of animal and vegetable life, let us now turn our attention to the mode of development of a new being in those belonging to the higher groups. The general nature of the formative process, in all instances where fertilised germs are produced, will be best understood by a short sketch of the phenomena ascertained to occur in different kinds of plants.

In the higher or phanerogamic plants it is generally well known that the combination of two parts of the flower is necessary to the production of a seed containing the embryo or young plant. Beginning with the discovery of the pollen-tubes by Amici in 1823, the careful and minute investigations of a long line of illustrious vegetable physiologists have brought to light the details of the process by which fertilisation is effected, and have shown, in fact, how the minute tube developed from the inner membrane of the pollen-granule, as soon as it falls upon the stigmatic tissue of the seed-bearing plant, insinuates itself by a rapid process of development between the cells of the style, and reaches at last the ovule, in the interior of which is the embryo-sac; how, having passed into the micropyle or orifice of the ovule, it makes its way to the embryo-sac; how a minute portion of the fertilising substance of the fovilla transudes from the pollen-tube into the cavity of the embryo-sac, in which by this time a certain portion of the protoplasm has become differentiated into the germinal vesicle—thereby stimulating it to further growth and development, the earliest phenomena of which manifest themselves by the formation of an investing cell-wall, and by the occurrence of cell-division, which results in the formation of the embryo or plantule of the seed.

Thus it appears that the essential part of the process of production in phanerogamic plants is the formation in the parent plant of cells of two different kinds, which by themselves have little or no independent power of further growth, but which, by their union, give rise to a product in which the power of development is raised to the highest degree.

By further researches it is now known that the same law prevails in all the remaining members of the vegetable kingdom, with the exception only of the very simplest forms.*

In viewing the reproductive process in the series of Cryptogamic plants, two facts at once strike us as remarkable in the modifications which are observed to accompany the formation of a productive germ, viz.:—First, that the difference between the two productive elements becomes as it were more prominent, or more highly specialised, in the Cryptogamic than in the Phanerogamic plants; and, second, that in the simpler and lower forms this difference gradually disappears till it is lost in complete uniformity of the productive elements.

Thus in the whole tribe of the Ferns and Vascular Cryptogams, in the higher Algæ and Fungi, in the Characeæ and in the Mosses, the differentiation of the productive elements is carried to a very high degree; for while that belonging to the embryo or germ presents the structure of a simple cell which remains at rest, or in a comparatively passive state, and, absorbing into itself the substance of the other, becomes the seat of subsequent development, the other, corresponding to the pollen of the staminiferous phanerogam, is usually separated from the place of its formation, and, having undergone a peculiar modification of structure by which it acquires active moving cilia, it changes place and is directed towards the germinal structure, and, coming in contact with its elementary cell, is more or less absorbed or lost in the fertilising process. The protoplasm of the germinal cell thus acted on and fertilised then proceeds to undergo the changes of development by which the foundation is laid for the new plant.

In the Algæ and Fungi, however, there are gradations of the differentiation of the two reproductive cells which are of the greatest interest in leading to a comprehension of the general nature of the formative process. For in the lower and simpler forms of these plants, such as the Desmidieæ, Mesocarpeæ, and other Conjugatæ, we find that there is no distinction in structure or form to be perceived between the two cells which unite or undergo conjugation; and a complete fusion or intermixture of the two masses of protoplasm results in the production of a single, usually spherical, mass holding the place of an embryo. And that there is an absence of specialisation between the two uniting cells is clearly shown, in both *Desmidium* and *Mesocarpus*, by the fact that the embryo or zygospore is formed in the mass resulting from the union of the protruded portions of the two cells; and in more ordinary cases, as in *Spirogyra*, where the embryo is formed in one of the two cells, it seems to be indifferent in which of them it is formed.

From this, which may be regarded as the most elementary type of new production by the union of the two cells, the transition is not a great one to the development of a progeny without any such union. We might conjecture, then, that the capacity for separate or individual existence extends in the lowest organisms to the whole or to each structural element of their organisation, while as we rise in the scale of vegetable life (and the same view might apply to the animal kingdom) this capacity is more and

* For the most interesting information on this subject I cannot do better than refer to the very able Reports by Dr. Burdon Sanderson in the "Reports of the Medical Officer of the Privy Council," 1873, 1874, and 1875.

* It will be observed that I leave entirely out of view the whole subject of the multiplication of plants by budding or simple division.

more divided between the two productive elements, or, at least, is only called into full action by their combination.

The germinal element consists of a simple primordial cell, varying in different kinds of plants, but in all of them probably containing the essential substance protoplasm; and the most immediate result or effect of fertilisation is the multiplication by repeated fissiparous division of the previously existing cells. The new individual resulting from this cellular growth usually remains within the parent body, without, however, direct union or continuity of tissue, till the embryo has attained some advancement, as in the well-known case of the seeds of a phanergnam; but there are many varieties in the mode of its disposal among the lower plants.

A remarkable exception to the more direct relation of the process of fertilisation to the formation of the new individual or embryo occurs in some plants, simulating in some respects that kind of variation in animal reproduction which has been named alternate generation. A well-known instance of this belongs to the Vascular Cryptogams. The prothallium of the Ferns, for example, results from the development of so-called spores or unicellular buds, which are familiar as being formed in small capsules on the lower leaf-surface; and in this prothallium, when it has reached a certain stage of vegetation, there are formed the archegonia, containing the oospheres or germ-cells, which are fertilised by the moving ciliated particles developed in the cells of the antheridia, leading to the production of a new spore-bearing plant.

Recent researcches have also called attention to the remarkable arrangements in Phanerogamic plants for the prevention of fertilisation of the pistils by pollen from the same flower, or even from the same plant. In the latter case this is effected by the separation of stamens and pistils in different flowers on the same or on different plants. In the former case, where both organs occur in the same flower, the adaptations, whether of a mechanical or of a physiological character, by which self-fertilisation is prevented, as ascertained by numerous recent investigations (among which those of Darwin are most conspicuous), are of the most varied and often the most complicated kind.

Let us now turn to the consideration of the Development of Animals; and let me say in the outset that it will be necessary for me to confine my remarks chiefly to the higher or vertebrated animals, and to certain parts only of the history of their development—more particularly the structure and formation of the ovum or egg, its earlier developmental changes, and the relation of these to the formation of the new animal.

I cannot enter upon the consideration of this topic without adverting to the very recent acquisition of some of the most important facts upon which this branch of knowledge is founded; and I feel it to be peculiarly appropriate, in the year of his death, to refer to a biologist whose labours contributed more powerfully than those of any other person to give to animal embryology the character of a systematic branch of science, and to whom we owe some most important original discoveries—I mean Karl Ernest von Baer, of Königsberg, St. Petersburg, and Dorpat.

Of observers who, previous to Von Baer, were mainly instrumental in preparing the way for the creation of a more exact modern science of embryology only two can be mentioned, viz., Caspar Frederick Wolf, of St. Petersburg, well known as the author of a work entitled "Theoria Generationis," published in 1759, by which the *epigenesis* or actual formation of the organs in a new being was first demonstrated, and Christian Pander, who, by his researches made at Würzburg, explained, in a work published in 1817, the principal changes by which the embryo arises and is formed.

Von Baer was born in the Russian province of Esthonia on the 29th of February, 1792. After having been fifteen years Professor in the Prussian University of Königsberg, he was called to St. Petersburg, and having some years later been appointed to a newly established professorship of Comparative Anatomy and Physiology, he remained in that city for nearly thirty years as the most zealous and able promoter of scientific education and research, stimulating and guiding all around him by his unexampled activity, comprehensive and original views, sound judgment, and cordial co-operation. In 1868, at the age of 76, he retired to Dorpat, from the University of which he had received his degree in 1814, and continued still to occupy himself with working and writing in his favourite subjects, as well as interesting himself in everything that was related to educational and scientific progress, to very near the time of his death, which occurred on the 28th of November, 1876, in his 85th year.

Although Von Baer's researches, according to the light in which we may now view them, contributed in no small degree to the introduction of the newer views of the morphological relations of organic structure which have culminated in the Theory of Descent, yet he was unwilling to adopt the views of Darwin; and one of his latest writings, completed in the last year of his life, was in vigorous opposition to that doctrine.

It would have been most interesting and instructive to trace the history of the progress of discovery in Embryology from the period of Von Baer down to the present time; but such a history would not be suitable to the purpose of this address; and I can only venture here, in addition to Rathke, the colleague of Baer in Königsberg, to select two names out of the long list of distinguished workers in this field during the last forty years, viz.:—Thomas Bischoff, of Giessen and Munich, to whom we owe the greatest progress in the knowledge of the development of Mammals, by his several memoirs, appearing from 1842 to 1854; and Robert Remak, of Berlin, whose researches on the development of Birds and Batrachia, appearing from 1850 to 1855, gave greatly increased exactness and extension to the general study of development.

The germinal element from which, when fertilised, the new animal is derived is contained within the animal ovum or egg—a compact and definite mass of organic matter, in which, notwithstanding great apparent variations, there is maintained throughout all the members of the animal kingdom, excepting the Protozoa, which are destitute of true ova, a greater uniformity in some respects than belongs to the germinal product of plants.

Usually more or less spherical in form, the animal ovum presents the essential characters of a "complete cell," in the signification given by Schwann to that term. The germinal substance is enclosed by an external vesicular membrane or *cell-wall*. Within this covering the *cell-substance* (generally named yolk or vitellus, from the analogy of the fowl's egg) consists, to a greater or less extent, of a mass of protoplssm; and imbedded in this mass, in a determinate situation, there is found a smaller internal vesicular body, the *germinal vesicle* or nucleus, with its more or less constant or variable *macula* or nucleolus.

Now the first thing which strikes us as remarkable connected with the ovum is the very great variation in size as compared with the entire animal, while in all of them the same simple or elementary structure is maintained. The ovum of mammals is, for example, a comparatively small body, of which the average diameter is about $\frac{1}{120}$ of an inch, and which consequently scarcely weighs more than a very minute fraction of a grain, which may be calculated perhaps only at the $\frac{1}{12\,000}$ part. And, further, in two animals differing so widely in size as the elephant and the mouse, the weights of which may be held to stand towards each other in the proportion of 150,000 to 1, there is scarcely any difference in the size of the mature ovum.

On the other hand, if we compare this small ovum of the mammal with the yolk of the egg in the common fowl, the part to which it most nearly corresponds, it may be

estimated that the latter body would contain above three millions of the smaller ova of a mammal.

The attribute of size, however, in natural objects ceases to excite feelings of wonder or surprise as our knowledge of them increases, whether that be by familiar observation or by more scientific research. We need not, at all events, on account of the apparent minuteness of the ovum of the mammifer or of any other animal, have any doubts as to the presence of a sufficient amount of germinal substance for explaining in the most materialistic fashion the transmission of the organic and other properties and resemblances between the parent and offspring. For we are led to believe, by those who have recently given their attention to the size of molecules composing both living and dead matter, that in such a body as this minute ovum of the mammal there may be as many as five thousand billions of molecules: and even if we restrict ourselves to the smaller germinal vesicle, and, indeed, to the smallest germinal particle which might be made visible by the highest microscopic enlargement, there are still sufficient molecules for all the requirements of the most exacting material biologist.*

This great disparity of size, however, is connected with an important difference in the disposition of the yolk-substance, according to which ova may be distinguished as of two kinds—the large- and the small-yolked ova, between which there are also many intermediate gradations. The larger-yolked ova belong to the whole tribe of birds, scaly reptiles, osseous and cartilaginous fishes, and the Cephalopods among the Invertebrates; and are distinguished by the strictly germinal part or protoplasm being collected into a small disk, known familiarly as the cicatricula of the fowl's egg, and to be seen as a whitish spot on that side of the yolk which naturally floats uppermost, while the rest of the yolk, of a deeper yellow colour, contains a large quantity of vitelline granules or globules of a different chemical nature from the protoplasm.

The phenomena of embryonic development are, in the first instance at least, confined to the germinal disk, and the rest of the yolk serves in a secondary or more remote manner to furnish materials for nourishment of the embryo and its accessory parts. Thus we distinguish the germinal from the nutritive or food-yolk, or, as the younger Van Beneden has named them, the *protoplasm* and the *deutoplasm*.

In the smaller ovum of the mammal, on the other hand, it seems as if the whole, or nearly the whole, of the yolk were protoplasmic or germinal. There may be some admixture of yolk-granules; but there is not the marked separation or limitation of the protoplasmic substance which is so distinct in birds, and the earliest changes of development extend to the whole component substance of the yolk, or, in other words, the yolk is entirely germinal. Hence some have given the names of *meroblastic* and *holoblastic* (meaning partially and entirely germinal) to these two contrasting forms of ova. There are many of the invertebrate animals of which the ova present the same entirely germinal arrangement as in those of mammals, and the *Amphioxus* may be included in the same group.

The Amphibia stand in some measure between the two extremes—the purely protoplasmic or germinal part occupying one side, and the nutritive or vitelline the other. But among the Invertebrates the gradations are often such as to make it difficult to determine under which group the ova should be placed.

The genesis or formation of the ovum itself, it it be considered with reference to its first origin, carries us back to a very early period of the formation of the parent in which it is produced; and it is one of the most interesting problems to determine what is the source of the cells in the parent from which the ova originally spring. All that I can venture to say at present in regard to this point is, that the primordial ova or germs appear in the parental body, while still embryonic, at a very early period of its development, and clearly derive their origin from a deeply-seated part of the formative cells which are undergoing transformation into the primitive organs; but the exact seat of the origin of the reproductive cells is still a matter of doubt.

When the ovum attains its full maturity in the ovary, the seat of its formation within the parent, it is separated from that organ, and when perfected proceeds to undergo embryonic development, a marked difference in this respect existing between the germinal product of the higher plants and animals.

The period of maturation of the ovum is marked in the greater number of animals by a series of phenomena which have generally been interpreted as the extrusion or absorption of the germinal vesicle; and various observers have actually traced the steps of the process by which that vesicle appears to leave the yolk and is lost to sight, or has passed into the space between the yolk and its membrane in the shape of the peculiar hyaline bodies named the *polar* or *directing* globules. But recent researches, afterwards to be referred to, tend to show that some part at least of the substance of the germinal vesicle remains to form, when combined with the fertilising element, the newly endowed basis of future development.

Among the earliest changes to which the perfect animal ovum is subject, I have first to refer to the segmentation of the germ, a series of phenomena the observation of which has been productive of most important results in leading to a comprehension of the intimate nature of the formative process, and which is of the deepest interest both in a morphological and histological point of view. This process, which was first distinctly observed by Prevost and Dumas more than fifty years ago, and is now known to occur in all animal ova, consists essentially in the cleavage or splitting up of the protoplasmic substance of the yolk, by which it becomes rapidly subdivided into smaller and more numerous elements, so as at last to give rise to the production of an organised stratum of cells out of which, by subsequent changes, the embryo is formed.

The process of yolk-segmentation may at once be distinguished as of two kinds, according as it affects in the small-yolked ova the whole mass of the yolk simultaneously, or in the large-yolked ova is limited to only one part of it. The cleavage process, in fact, affects the germinal and not the food-yolk; so that to take the two most contrasting instances of the bird and mammal, to which I have before referred, it appears that while the mammal's ovum undergoes entire segmentation, this process is confined to the substance of the cicatricula or germinal disk of the bird's egg. This process is essentially one of cell-division, but it is also in some measure one of cell formation. The best idea of its nature will be obtained from a short description of the total segmentation occurring in the mammal's ovum.

When, as before mentinned, the germinal vesicle has been in part extruded or lost to sight, the whole yolk-substance of the ovum forms a nearly uniform mass of finely granular protoplasm, enclosed within the external cell-membrane. Within a few hours later a clear nucleus has arisen in this mass. To this more definite form of organisation assumed by the germinal substance of the future animal, which is about to be the subject of the segmenting process, the name of the first segment-sphere may be given.

By the process of cleavage which now begins, this first segment-sphere and its nucleus undergo division into two nucleated spheres of smaller size, the whole substance of

* According to a calculation made by Mr. Sorby, the number of molecules in the germinal vesicle of the mammalian ovum is such that if one molecule were to be lost in every second of time the whole would not be exhausted in seventeen years. See Address to the Microscopic Society, in *Journ. of Microscop. Science*, vol. xv., p. 225, and *Nature*, vol. xiii., p. 332. See also Darwin on "Pangenesis," in his work on "Variations," &c. (1868), vol. ii., p. 374, and the Review by Ray Lankester of Haeckel's work, "Perigenesis der Blastidule," &c., in *Nature* for 1876, p. 235, and Ray Lankester's essay on "Comparative Longevity," 1870.

the yolk, in a holoblastic ovum, such as that of the mammal, being involved in the segmenting process.

The second stage of division follows after the lapse of a few hours, and results in the formation of four nucleated segment-spheres; and the process of division being repeated in a certain definite order, there result in the succeeding stages (that is, the third, fourth, fifth, and up to the tenth) the numbers of 8, 12, 16, 24, 32, 48, 64, and 96 nucleated yolk-spheres, germ-spheres, or formative cells.

In the rabbit's ovum the tenth stage is reached in less than three days; and as during that time the size of the whole ovum has undergone very little increase, it follows that the spheres of each succeeding set, as they become more numerous, have diminished greatly in size. These segment-spheres are all destitute of external membrane, but are distinctly nucleated; and their protoplasmic substance is more or less granular, presenting the usual histological characters of growing cells.

By the time that segmentation has reached the seventh or eighth stage, when 32 or 48 spheres have been formed, the ovum has assumed the appearance of a mulberry, in which the outer smaller spheres, closely massed together, project slightly and uniformly over the whole surface; while the interior of the ball is filled with cells of a somewhat larger size and a more opaque granular aspect, also resulting from the process of segmentation.

Already, however, the mutual compression of the spheres or cells on the surface, by their crowding together, has led to the flattening of their adjacent sides; and by the time the tenth stage is reached, when the whole number of the cells is about 96, the more advanced superficial cells, having ranged themselves closely together, form a nucleated cellular layer or covering of the yolk, enclosing within them the larger and more opaque cells, derived like the first from the segmenting process. In a more advanced stage, the deeper cells now referred to having also taken the form of a layer, there results at last the bilaminar blastoderm or embryonic germinal membrane.

The process of partial segmentation, such as occurs in the bird's egg, though perhaps fundamentally the same as that of the mammal previously described, stands in a different relation to the parts of the whole yolk or egg, and consequently differs in its general phenomena. The segmentation is mainly restricted in the meroblastic ova of birds to the germinal disk of cicatricula, and does not immediately involve any part of the larger remainder of the yolk. This takes place during the time of the descent of the yolk through the oviduct, when the yolk is receiving the covering of the white or albumen, the membrane, and the shell previous to being laid—a progress which, in the common domestic fowl, usually occupies less than twenty-four hours. Corresponding essentially to the more complete segmentation of the mammal's ovum, the process leads to the same result in the production of two layers of nucleated formative cells in the original seat of a protoplasmic disk—a bilaminar blastoderm resulting as in the mammal's ovum, though in a somewhat different relation to the yolk.

I will not fatigue you with a description of the details of these phenomena, interesting as they may be, but only mention generally that they consist in the formation of deep fissures running from the surface into the substance of the germ-disk. The first of these fissures crosses the disk in a determinate direction, dividing it into two nearly equal semicircular parts. In the next stage another fissure, crossing the first nearly at right angles, produces four angular segments. Then come four intervening radial fissures which subdivide the four segments into eight; and next afterwards the central angles of these eight radial segments are cut off from their peripheral portions by a different fissure, which may be compared to one of the parallels of latitude on the globe near the pole where the radial or *longitude* fissures converge. And so thereafter, by the succession and alternation of radial and circular clefts (which, however, as they extend outwards, come soon to lose their regularity), the whole germinal disk is divided into the two layers of nucleated cells, constituting the blastoderma or germinal membrane of Pander and all subsequent embryologists.* If a laid egg be subjected to the heat of incubation for eight or ten hours, the cicatricula, now converted into this segmented blastoderm, is found to be considerably expanded by a rapid multiplication of its constituent cells; and in as many more hours, by further changes in its substance, the first lineaments of the chick begin to make their appearance. Similar changes affect the blastoderm of the mammal; and thus it appears that the result of segmentation, in the bird as well as in the mammal and other animals, is the production of an organised laminar substratum, which is the seat of the subsequent embryonic development.

I must still request your attention to some details connected with the process of segmentation, which bear upon the question of the origin of the new cells, and on which recent research has thrown a new and unexpected light.

With respect to the nature of the first segment-sphere of the ovum and the source of its nucleus, as well as of the other segment-spheres or cells which follow each other in the successive steps of germ-subdivision, it appears probable, from the researches of several independent observers, and more especially of Edward van Beneden and Oscar Hertwig, that in the course of the extrusion of the germinal vesicle a small portion of it remains behind in the form of a minute mass of hyaline substance, to which Van Beneden has given the name of *pronucleus*, and that, as the result of the fertilising process, there is formed a second similar hyaline globule or pronucleus, situated near the surface, which gradually travels towards the centre and unites with the first pronucleus, and that these two pronuclei, being fused together, form the true nucleus of the first segment-sphere. According to this view the original germinal vesicle, when it disappears or is lost to sight, as described by so many embryologists, is not dissipated, but only undergoes changes leading to the formation of the new and more highly endowed nucleus of the first embryonic or segmental sphere. It further appears that the subdivision of each segmenting mass is preceded by a change and division of the nucleus, and that this division of the nucleus is accompanied by the peculiar phenomenon of a double conical or spindle-shaped radial lineation of the protoplasm, which, if we were inclined to speculate as to its nature, seems almost as if it marked out the lines of molecular force acting in the organising process. These lines, however, it will be understood, if visible with the microscope, even of the highest magnifying-power yet attained, belong to much larger particles than those of the supposed molecules of the physicist; but, considered in connexion with what we know of the movements which frequently precede the act of division of the yolk-spheres, we seem in this phenomenon to have made some near approach to the observation of the direction in which the molecular forces operating in organisation may be supposed to act.†

* The more exact nature of the process of segmentation was first made known by the interesting researches of Bagge in 1841, and more especially of Kölliker in 1843. The phenomena of complete segmentation were first fully described in the mammal's ovum in Bischoff's description of the development of the Rabbit, 1842, and followed out in his succeeding memoirs on the Dog, Guinea-pig, and Roedeer. The phenomena of partial segmentation were first made known, in their more exact form, by Kölliker's researches on the development of the Cephalopoda, published in 1844. In birds the process was first described by Bergmann in 1847, and more fully by Coste in 1849.

† The observations referred to above as to the division of the nucleus are so novel and of such deep interest that I am tempted to add here a short abstract of their more important results from a very clear account given of them by Dr. John Priestley, of Owens College, Manchester, in the *Journal of Microscopical Science* for April, 1876.

The researches now referred to are those of Auerbach, Butschli, Strasburger, Hertwig, and Edw. Van Beneden; and the following may be stated as the points in which they mainly agree:—

The nucleus when about to divide elongates into a spindle-shaped body, becomes irregular and indistinct, acquires a granular disk or zone in the plane of its equator; this divides into two, and each half moves towards the pole of the spindle on its own side, there being radiated lines of protoplasm between the poles and the equatorial disk.

With respect to the nature of the blastoderm, the organised cellular stratum resulting from segmentation, and its relation to the previous condition of the ovum on the one hand, and the future embryo on the other, there is presented to us, by modern research, the interesting view that the blastoderm consists, after completion of the segmenting process, of two layers of cells—an outer or upper (usually composed of smaller, clearer, and more compact nucleated cells) named *ectoderm* or *epiblast*, and an inner or lower (consisting of cells which are somewhat larger, more opaque and granular, but also nucleated), named *endoderm* or *hypoblast*.

In the meroblastic ova, such as those of birds, the bilaminar blastoderm is discoid and circumscribed as it lies on the yolk-surface, and only comes to envelop the whole of the food-yolk in the progress of later development; while in the holoblastic ova, and more especially in mammals, the blastoderm from the first extends over the whole surface of the yolk, and thus forms an entire covering of the yolk known as the "vesicular blastoderm," the space within being occupied by fluid.

Huxley long ago presented the interesting view that these two layers are essentially the same, in their morphological relations and histological structure, as the double wall of the body in the simplest forms of animals above the Protozoa; and Haeckel has more recently followed out this view, and supported it by his researches in the Calcareous Sponges, and has founded upon it his well-known *Gastræa* theory. According to this view all animals take their origin from a form *Gastrula*. In the simpler tribes, as in the instance of the common fresh-water polype or Hydra, they proceed no further than the Gastrula stage, unless by mere enlargement and slight differentiation of the two primitive layers of cells representing the persistent ectoderm and endoderm.*

If, pursuing this idea, we take a survey of the whole animal kingdom in its long gradation of increasing complexity of form and structure from the simplest animal up to man himself, we find that all the various modifications of organic structure which present themselves are found, in the history of the individual or ontological development of the different members of the series, to spring originally from two cellular laminæ, ectoderm and endoderm, the component elements of which may again be traced back to the first segment-sphere and primitive protoplasmic elements of the ovum.

Time does not admit of my conducting you through the chain of observation and reasoning by which Haeckel seeks to convince us of the universal applicability of his theory; but I cannot avoid calling your attention to the extremely interesting relation which has been shown to exist between the primary phases of development of the ovum and the foundation of the blastoderm in very different groups of animals, more especially by the researches of Haeckel himself, of Kowalevsky, Edward Van Beneden, and others, and which has received most efficient support from the investigations and writings of E. Ray Lankester in our own country; so that now we may indulge the well-grounded expectation that, notwithstanding the many and great difficulties which doubtless still present themselves in reconciling various forms with the general principle of the theory, we are at least in the track which may lead to a consistent view of the relations subsisting between the ontogenetic, or individual, and the phylogenetic, or race history of the formation of animals and of man.*

In all animals, then, above the Protozoa, the ovum presents, in some form or other, the bilaminar structure of ectoderm and endoderm at a certain stage of its development, this structure resulting from a process of segmentation or cell-cleavage; and there are three principal modes in which the double condition of the layers is brought about. In one of these it is by inward folding or invagination of a part of the single layer of cells immediately resulting from the process of segmentation that the doubling of the layers is produced; in the second, perhaps resolvable into the first, it may be described rather as a process of enclosure of one set of cells within another; while in the third the segmented cells, arranged as a single layer round a central cavity of the ovum, divide themselves later into two layers. But the distinction of ectodermic and endodermic layers of cells is maintained, whether it be primitive and manifested from a very early period, or acquired later by a secondary process of differentiation. Thus in many Invertebrates, as also in *Amphioxus* among the Vertebrates, a distinct invagination occurs, while in Mammals, as recently shown by Van Beneden's most interesting observations in the rabbit's ovum, and probably also in some Invertebrates, the cells of the ectoderm gradually spread over those of the endoderm during the progress of segmentation, and thus the endodermic comes to be closed by the ectodermic layer of cells.

From the very novel and unexpected observations of Van Beneden it further appears that from the earliest period in the process of segmentation in the mammal's ovum it is possible to perceive a distinction of two kinds of segment-spheres or cells, and that when this process is traced back to its first stage it is found that the whole of the cells belonging to the ectoderm are the progeny of, or result from the division of the upper of the two first formed segments, and that the whole of the endodermic cells are the descendants of the lower of the two first segmented cells. This, however, is not an isolated fact belonging only to mammalian development, but one which very nearly repeats a process ascertained to occur in a considerable number of the lower animals, and it seems to promise the means of greatly advancing the comprehension of the whole process of blastodermic formation. Thus ectoderm and endoderm, or the primordial rudiments of the future animal and vegetative systems of the embryo, are traced back as distinct from each other to the first stage of segmentation of the germ.

Accepting these facts as ascertained, they may be regarded as of the deepest significance in the phylogenetic history of animals; for they appear to open up the prospect of our being able to trace transitions between the earliest embryonic forms occurring in the most different kinds of ova, as between the discoid or meroblastic and the vesicular or holoblastic, through the intermediate series which may be termed amphiblastic ova.

In the lowest animals, the two layers already mentioned,

* I ought here to refer to the elaborate memoirs of Professor Semper on the morphological relations of the Vertebrate and Invertebrate animals, contained in the *Arbeiten aus dem Zoolog.-zootom. Institut in Würzburg*, 1875 and 1876, in which the conclusions arrived at do not coincide with the views above stated.

The first segments are the new nuclei, and the subsequent division of the cell takes place in the intermediate space.

Although these observers still differ in opinion upon some of the details of this process, and especially as to the fate of the germinal vesicle, all of them seem to agree that there are two primitive or distinct hyaline parts of the yolk-protoplasm, a superficial and a deep one, engaged in the formation of the new nucleus; and both Hertwig and Van Beneden are of opinion that the two proceed from different parts of the yolk-protoplasm.

The radiated structure of the nuclei had been previously recognised by Fol and Flemming, and further observed by Oellacher.

1. Further researches are published in the *Nova Act. Nat.-Cur.*, 1873, and in the *Zeitschr. für Wissensch. Zool.*, vol. xxv.

2. Auerbach's observations in his "Organolog. Studien," 1874.

3. Strasburger's observations in his memoir "Ueber Zellbildung und Zelltheilung," Jena, 1875.

4. Edouard Van Beneden's researches, partly in his memoir "On the Composition and Significance of the Egg," &c., presented to the Belgian Academy in 1875, and more particularly in the extremely interesting preliminary account of "Researches on the Development of Mammalia," &c., 1875, and in a separate paper in the *Journal of Microscopical Science* for April, 1876.

5. Oscar Hertwig's memoirs are contained in the *Morphol. Jahrbuch*, 1875, and his most interesting and novel observations in the same work, 1877.

† At this place I will only refer to one of the most recent of Haeckel's works, in which the views alluded to above are fully exposed in a series of most interesting memoirs, viz., "Studien zur Gastræa-Theorie," Jena, 1877: and to Dr. E. Percival Wright's translation of the account of Haeckel's views in *Journ of Microsc. Science*, vol. xiv., p. 71.

viz., ectoderm and endoderm, are the only ones known to constitute the basis of developmental organisation; but as we rise in the scale of animals we find a new feature appearing in their structure, which is repeated also in the history of the formation of the blastoderm in the higher animals up to man. This consists in the formation of an intermediate layer or layers constituting the *mesoderm*, with which, in by far the greater number, is connected the formation of some of the most important bodily structures, such as the osseous, muscular, and vascular systems.

I will not stop to discuss the very difficult question of the first origin of the mesoderm, upon which embryologists are not yet entirely agreed, but will only remark that a view originally taken of this subject by the acute Von Baer appears more and more to gain ground; and it is this—that the mesoderm, arising as a secondary structure, that is, later than the two primary layers of ectoderm and endoderm (corresponding to the serous and mucous layers of Pander), is probably connected with or derived from both of these primitive layers, a view which it will afterwards appear is equally important ontogenetically and phylogenetically.

But whatever may be the first origin of the mesoblast, we know that in the Vertebrata this layer, separating from between the other two, and acquiring rapidly by its cell-multiplication larger proportions and much greater complexity than belongs to either ectoderm or endoderm, speedily undergoes further subdivision and differentiation in connexion with the appearance of the embryonic organs which arise from it, and in this respect contrasts greatly with the simplicity of structure which remains in the developed parts of the ectodermic and endodermic layers. Thus, while the ectoderm supplies the formative materials for the external covering or epidermis, together with the rudiments of the central nervous organs and principal sense organs, and the endoderm by itself only gives rise to the epithelial lining of the alimentary canal and the cellular part of the glands connected with it, the mesoblast is the source of far more numerous and complex parts, viz., the whole of the true skin or corium, the vertebral column and osseous system, the external voluntary muscles and connective tissue, the muscular walls of the alimentary canal, the heart and blood-vessels, the kidneys, and the reproductive organs, thus forming much the greatest bulk of the body in the higher animals.*

There is, however, a peculiarity in the mode of the earliest development of the mesoblast which is of great importance in connexion with the general history of the disposition of parts in the animal body, to which I must now refer. This consists in the division of the mesoblast in all but its central part into two laminæ, an outer or upper and an inner or lower, and the separation of these by an interval or cavity which corresponds to the space existing between the outer wall of our bodies and the deeper viscera, and which, from the point of view of the vertebrate animals is called the pleuro-peritoneal cavity, but, viewed in the more extended series of animals down to the Annuloida, may receive the more general appellation of pleuro-splanchnic or parieto-visceral cavity, or, shortly, the *cœlom*. Thus, from an early period in the vertebrate embryo, and in a considerable number of the invertebrate, a division of the mesoderm takes place into the somatopleural or outer lamina and the splanchnopleural or inner lamina—the outer being the seat of formation of the dermal, muscular, and osseous systems (the voluntomotory of Remak), and the inner of the muscular wall of the alimentary canal, as well as of the contractile substance of the heart and the vascular system generally.

It is interesting to find that there is a correspondence between the later division of the mesoderm of the higher animals derived from the two primitive blastodermic laminæ and the original absence of mesodermic structure in the lowest animals, followed by the gradual appearance, first of one layer (the external muscular in the higher Cœlenterata), and soon afterwards by the two divisions or laminæ with the intermediate cœlom.

In this account of what may be termed the organised foundation of the new being, I have entered into some detail, because I felt that our conception of any relation subsisting between the ontogenetic history of animals and their phylogenetic evolution can only be formed from the careful study of the earliest phenomena of embryonic organisation. But, notwithstanding the many difficulties which unquestionably still block the way, I am inclined to think that there is great probability in the view of a common bilaminar origin for the embryo of all animals above the Protozoa, and that the vertebrate equally with the invertebrate animals may be shown to possess, in the first stages of their blastodermic or embryonic formation, the two primitive layers of ectoderm and endoderm.

To attempt, however, to pursue the history of the development of animals in detail would be equivalent to inflicting upon you a complete system of human and comparative anatomy. But I cannot leave the subject abruptly without an endeavour to point out, in the briefest possible manner, the bearing of one or two of the leading facts in embryology upon the general relation of ontogeny and phylogeny.

We are here brought into the contemplation of those remarkable changes, all capable of being observed and demonstrated, by which the complex organisation of the body is gradually built up out of the elementary materials furnished by the blastodermic layers—a process which has been looked upon by all those who have engaged in its study with the greatest interest and admiration. And if, by comparing these phenomena as observed in individuals belonging to different classes and orders of animals, it is found that not only are they not different, but, on the contrary, that they present features of the most remarkable resemblance and conformity, we shall be led to conclude that there is a general plan of development proved to extend to the members of considerable groups, and possibly capable of being traced from one group to another. But this is clearly nothing else than another way of stating that there is a similar type of structure pervading the animals of each group, and a probability of a common type being ascertained to belong to them all. The main question, therefore, to be answered is, whether there is or is not a general correspondence between the phenomena of development and the gradation of type in animal structure upon which anatomists and zoologists are agreed; and my object will now be to bring rapidly before you one or two of the most marked illustrations of the correspondence, drawn from the early history of development in the higher animals.

As one of the examples of the earlier phenomena of development I may refer to the change which is perceptible as early as the eighteenth or twentieth hour of incubation in the chick, and which is reproduced in the course of development of every member of the Vertebrate subkingdom. It consists in the formation of cross clefts on each side of the primitive neural cavity, which divide off from each other a number of segments of this wall in length of the axis of the embryo. At first there are only one or two such clefts; but they rapidly increase in a backward direction in the body of the embryo, and as development proceeds they extend into the tail itself. These are the *proto-vertebræ* of embryologists—not corresponding, as might at first be supposed, with the true or actual vertebræ which are formed later, but representing in an

* If we reserve the words ectoderm and endoderm to designate the two layers of the primary bilaminar blastoderm, we may apply the terms epiblast and hypoblast to their derivatives after the formation of the mesoderm, and indicate the relations of the whole to the secondary or quadrilaminar blastoderm by the following Table:—

Primary Blastoderm	Ectoderm	.....	Epiblast	Secondary Blastoderm.
	Mesoderm	Somatopleure ..		
		Splanchnopleure		
	Endoderm	.....	Hypoblast	

interesting manner transverse *vertebral segments* of the body, and containing within each the elements of a great part of the structure belonging to the body-wall afterwards to be developed, including the true cartilaginous or osseous vertebral arches and the muscular plates.

This change, however, belongs to the mesodermic lamina, and occurs in an elongated thick portion of it, which makes its appearance on each side of the primitive neural canal between the epiblast and the hypoblast. The transverse cleavage is ascertained to commence near what afterwards forms the first cervical vertebra, but does not extend into the base of the cranium. And it is most interesting to note in this cleavage the formation at so early a period of the succession of *metameres* or series of similar parts, which forms a main characteristic of vertebral organisation.

As intimately connected with the formation of the vertebral column, the appearance of the chorda dorsalis or *notochord* presents many points of peculiar interest in embryological inquiries.

The notochord is a continuous median column or thread of cellular structure running nearly the whole length of the rudimentary body of the embryo, and lying immediately below the cerebro-spinal canal. It occupies, in fact, the centre of the future bodies of the vertebræ. It exists as a primordial structure in the embryo of all Vertebrates, including man himself and extending down to the Amphioxus, and, according to the remarkable discovery of Kowalevsky in 1866, it is to be found among the Invertebrates in the larva of the Ascidia.*

In Amphioxus and the Cyclostomatous Fishes the notochord, growing with the rest of the body into a highly developed form, acts as a substitute for the pillar of the bodies of the vertebræ, no vertebral bodies being developed; but in Cartilaginous and Osseous Fishes various gradations of cartilaginous and osseous structures come to surround the notochord and give rise to the simpler forms of vertebral bodies, which undergo more and more distinct development in the higher Vertebrates. In all instances the substance forming the vertebral bodies is deposited on the surface of or outside the notochord and its sheath, so that this body remains for a time as a vestigial structure within the vertebral bodies of the higher animals.

The observations of Kowalevsky with respect to the existence of a notochord in the Ascidia, which have been confirmed by Kupfer and others, have produced a change little short of revolutionary in embryological and zoological views, leading as they do to the support of the hypothesis that the Ascidian is an earlier stage in the phylogenetic history of the mammal and other Vertebrates. The analogy between the Amphioxus and Ascidian larva is certainly most curious and striking as regards the relation of the notochord to other parts; and it is not difficult to conceive such a change in the form and position of the organs, in their passage from the embryonic to the adult state, as is not inconsistent with the supposition that the Vertebrates and the Ascidia may have had a common ancestral form. Kowalevsky's discovery opens up at least an entirely new path of inquiry; and we must be prepared to modify our views as to the entire separation of the Vertebrates from the other groups of animals, if we do not at once adopt the hypothesis that through the Ascidian and other forms the origin of the Vertebrates may be traced downwards in the series to the lower grades of animal organisation.

The notochord extends a short way forward into the cranial basis; and an interesting question here presents itself, beginning with the speculations of Goethe and Oken, and still forming a subject of discussion, whether the series of cranial or cephalic bones is comparable to that of the vertebræ. On the whole it appears to me that it is consistent with the most recent views of the development and anatomy of the head to hold the opinion that it is composed of parts which are to some extent homologous with vertebral metameres.*

The history of the formation of the vertebral column presents an interesting example of the correspondence in the development of the individual and the race, in that all the stages which have been referred to as occurring in the gradual evolution of the vertebral column in the series of Vertebrates are repeated in the successive stages of the embryonic development of the higher members of the series.

There is perhaps no part of the history of development in the Vertebrates which illustrates in a more striking manner the similarity of plan which runs through the whole of them than that connected with what I may loosely call the region of the face and neck, including the apparatus of the jaws and gills. The embryonic parts I now refer to consist of a series of symmetrical pairs of plates which are developed at an early period below the cranium, and may therefore, in stricter embryological terms, be styled the *subcranial plates*.

Without attempting to follow out the remarkable changes which occur in the development of the nose and mouth in connexion with the anterior set of these plates (which, from being placed before the mouth, are sometimes named *pre-oral*), I may here refer shortly to the history of the plates situated behind the mouth, which were discovered by Rathke in 1826, and formed the subject of an elaborate investigation by Reichert in 1837.

These plates consist of a series of symmetrical bars, four in number in mammals and birds, placed immediately behind the mouth, separated by clefts passing through the wall of the throat, and each traversed by a division of the great artery from the heart—thus constituting the type of a branchial apparatus, which in fishes and Amphibia becomes converted into the well-known gills of these animals; whilst in reptiles, birds, and mammals they undergo various changes leading to the formation of very different parts, which could not be recognised as having any relation to gill-structure, but for the observation of their earlier embryonic condition. The history of this part of development also possesses great interest on account of the extraordinary degree of general resemblance which it gives to the embryos of the most different animals at a certain stage of advancement (so great, indeed, that it requires a practised eye to distinguish between the embryos of very different orders of mammals, and even between some of them and the embryos of birds or reptiles), as well as in connexion with the transformations of the first pair of branchial apertures, which lead to the formation of the passage from the throat to the ear in the higher Vertebrata. There is equal interest attached to the history of the development of the first pair of arches, which include the basis of formation of the lower jaw with the so-called *cartilage of Meckel*, and which, while furnishing the bone which suspends the lower jaw in reptiles and birds, is converted in mammals into the hammer-bone of the ear.

The other arches undergo transformations which are hardly less marvellous, and the whole series of changes is such as never fails to impress the embryological inquirer with a forcible idea of the persistence of type and the inexhaustible variety of changes to which simple and fundamental parts may be subject in the process of their development.

It is also of deep significance, in connexion with the foregoing phenomena, to observe the increase in the number of the gill-bars and apertures as we descend in the scale to the cartilaginous fishes and lampreys, and the still further multiplication of these metameres or repeated parts in the Amphioxus; and it is, perhaps, also interest-

* *Mem. de l'Acad. de St. Petersbourg*, vol. x.

* See the interesting and valuable memoirs of W. K. Parker, "On the Anatomy and Development of the Vertebrate Skull," in *Trans. of R. Soc.*; the researches of Gegenbaur, Mihalkovics, and more particularly the memoirs by F. M. Balfour, "On the Development of the Elasmobranch," in the *Journ. of Anat. and Physiol.*, vols. x. and xi.

ing to note that in the Ascidia the arrangement of the gills is exactly similar to that of the Amphioxus.

The study of the comparative anatomy of the heart and its mode of formation in the embryo furnishes also most striking illustrations of the relation between ontogenetic and phylogenetic development in the Vertebrates, and is not without its applications to some of the invertebrate groups of animals.

I need only recall to your recollection the completely double state of this organ in warm-blooded animals, by which a regular alternation of the systematic and pulmonary circulations is secured, and the series of gradations through the class of Reptiles by which we arrive at the undivided ventricle of the amphibian, and the further transition in the latter animals by which we come at last to the single heat of fishes; and to state that in the embryo of the higher animals the changes by which the double heart is ultimately developed out of an extremely simple tubular form, into which it is at first moulded from the primitive formative cells, are, in the inverse order, entirely analogous to those which I have just now indicated as traceable in the descending series of vertebrate animals; so that at first the embryonic heart of man and other warm-blooded animals is nothing more than a rhythmically contractile vascular tube. By the inflection of this tube, the constriction of its wall at certain parts, and the dilatation at others, the three chambers are formed which represent the single auricle, the single ventricle, and the aortic bulb of the fish. By later changes a septum is formed to divide the auricles, being completed in all the air-breathing animals, but remaining incomplete in the higher animals so long as the conditions of fœtal life prevent the return of arterialised blood to the left auricle. The growth of another septum within the ventricular portion gradually divides that cavity into two ventricles, repeating somewhat in its progress the variations observed in different reptiles, and attaining its complete state in the crocodile and warm-blooded animals.

I must not attempt to pursue this interesting subject further; but I cannot avoid making reference to the instructive view presented by the embryological study of the nature of the malformations to which the heart is subject, which, as in many other instances, are due to the persistence of transitory conditions which belong to different stages of progress in the development of the embryo. Nor can I do more than allude to the interesting series of changes by which the aortic bulb, remaining single in fishes and serving as the channel through which the whole stream of blood leaving the heart is passed into the gills, becomes divided in the higher animals into the roots of the two great vessels, the aorta and the pulmonary artery, and the remarkable transformation of the vascular arches which proceed from the aortic bulb along the several branchial arches, and which, in the gills of fishes and aquatic Amphibia undergo that minute subdivision which belongs to the vascular distribution of gills, but which in the higher non-branchiated animals are the subject of very different and various changes, in the partial obliteration of some and the enlargement of others, by which the permanent vessels are produced.

These changes and transformations have for many years been a subject of much interest to comparative anatomists, and will continue to be so, not only from their presenting to us one of the most remarkable examples of conformity in the plan of development and the type of permanent or completed organisation in the whole series of vertebrated animals, but also because of the manifest dependence of the phenomena of their development upon external influences and atmospheric conditions which affect the respiration, nutrition, and modes of life of the animal.

Nor is the correspondence to which I now refer entirely limited to the Vertebrata. For here, again, through the Amphioxus and the Ascidia, we come to see how an affinity may be traced between organs of circulation and respiration which at first appear to belong to very different types. The heart of vertebrates is, as is well known, an essentially concentrated form of vascular development in the ventral aspect of the body, while the heart of the invertebrate, whether in the more concentrated form existing in the Articula a nd Mollusca, or in a more subdivided shape prevalent in the Annelida, is most frequently dorsal; yet the main aorta of the Vertebrates is also dorsal; and it is not impossible, through the intermediate form of Amphioxus, to understand how the relation between the Vertebrate and the Invertebrate type of the blood-vascular system may be maintained.

But I am warned by the lapse of time that I must not attempt to pursue these illustrations further. In the statement which I have made of some of the more remarkable phenomena of organic production—too long, I fear, for your endurance, but much too brief to do justice to the subject—it has been my object mainly to show that they are all more or less closely related together by a chain of similarity of a very marked and unmistakable character; that in their simplest forms they are indeed, in so far as our powers of observation enable us to know them, identical; that in the lower grades of animal and vegetable life they are so similar as to pass by insensible gradations into each other; and that in the higher forms, while they diverge most widely in some of their aspects in the bodies belonging to the two great kingdoms of organic nature, and in the larger groups distinguishable within each of them, yet it is still possible, from the fundamental similarity of the phenomena, to trace in the transitional forms of all their varieties one great general plan of organisation.

In its simplest and earliest form that plan comprises a minute mass of the common nitrogenous hydrocarbon compound to which the name of protoplasm has been given, exhibiting the vital properties of assimilation, reproduction, and irritability. The second stage in this plan is the nucleated and enclosed condition of the protoplasmic mass in the organised cell. We next recognise the differentiation of two productive elements, and their combination for the formation of a more highly endowed organising element in the embryonic germ-sphere or cell; and the fourth stage of advance in the complexity of the organising phenomena is in the multiplication of the fertilised embryo-cell and its conversion into continuous organised strata, by further histological changes in which the morphological foundations of the future embryo or new being are laid.

I need not now recur to the further series of complications in the formative process by which the bilaminar blastoderm is developed and becomes trilaminar or quadrilaminar, but only recall to your recollection that while these several states of the primordial condition of the incipient animal pass insensibly into each other, there is a pervading similarity in the nature of the histological changes by which they are reached, and that in the production of the endless variations of form assumed by the organs and systems of different animals in the course of their development, the process of cell-production, multiplication, and differentiation remains identical. The more obvious morphological changes are of so similar a character throughout the whole, and so nearly allied in the different larger groups, that we are led to regard them as placed in some very close and intimate relation to the inherent properties of the organic substance which is their seat, and the ever-present influence of the vital conditions in which alone these properties maaifest themselves.

The formative or organising property therefore resides in the living substance of every organised cell and in each of its component molecules, and is a necessary part of the physical and chemical constitution of the organising elements in the conditions of life; and it scarcely needs to be said that these conditions may be as varied as the countless numbers of the molecules which compose the smallest particles of their substance. But, setting aside all speculation of a merely pangenetic kind, it appears to

me that no one could have engaged in the study of embryological development for any time without becoming convinced that the phenomena which have been ascertained as to the first origin and formation of textures and organs in any individual animal are of so uniform a character as to indicate forcibly a law of connexion and continuity between them; nor will his study of the phenomena of development in different animals have gone far before he is equally strongly convinced of the similarity of plan in the development of the larger groups, and, to some extent, of the whole. I consider it impossible, therefore, for any one to be a faithful student of embryology, in the present state of science, without at the same time becoming an evolutionist. There may still be many difficulties, some inconsistencies, and much to learn, and there may remain beyond much which we shall never know; but I cannot conceive any doctrine professing to bring the phenomena of embryonic development within a general law which is not, like the theory of Darwin, consistent with their fundamental identity, their endless variability, their subjugation to varying external influences and conditions, and with the possibility of the transmission of the vital conditions and properties, with all their variations, from individual to individual, and, in the long lapse of ages, from race to race.

I regard it, therefore, as no exaggerated representation of the present state of our knowledge to say that the ontogenetic development of the individual in the higher animals repeats in its more general character, and in many of its specific phenomena, the phylogenetic development of the race. If we admit the progressive nature of the changes of development, their similarity in different groups, and their common characters in all animals—nay, even in some respects in both plants and animals—we can scarcely refuse to recognise the possibility of continuous derivation in the history of their origin; and however far we may be, by reason of the imperfection of knowledge of Palæontology, Comparative Anatomy, and Embryology, from realising the precise nature of the chain of connexion by which the actual descent has taken place, still there can be little doubt remaining in the mind of any unprejudiced student of embryology that it is only by the employment of such an hypothesis as that of Evolution that further investigation in these several departments will be promoted, so as to bring us to a fuller comprehension of the most general law which regulates the adaptation of structure to function in the Universe.

At the conclusion of the Address a vote of thanks to the President was proposed by the Earl of Mount Edgcumbe, seconded by Dr. Henry Acland, and carried by acclamation.

ADDRESS TO THE CHEMICAL SECTION

BY

Professor ABEL, F.R.S., &c.,
President of the Section.

The subject which my predecessor in the honourable position of President of this Section made the chief topic of his interesting and instructive Address, affords excellent illustrations of the operation of purely scientific research in creating and developing important branches of industry. Mr. Perkin, whose name has from the very commencement of the history of coal-tar colours been identified with their discovery and their scientific and technical history, referred to several series of researches, each one of which formed a link in a chain of discoveries in organic chemistry, of the highest value as establishing, illustrating, or extending important chemical theories, but, at the time and for long afterwards, of value purely from a scientific point of view. These researches, undertaken and pursued by ardent and philosophical investigators under more of less formidable difficulties and solely in the interests or Science, resulted in the discovery of certain organic bodies which were produced originally only on a very small scale and at great cost, but which, after the lapse of years, have been readily manufactured from abundant sources, and have constituted important elements in the development of the industry of artificial colouring-matters. In fact this industry—which owes its origin to the discovery of mauve by Mr. Perkin, about twenty years ago, and which is second to no branch of chemical industry in regard to the rapidity of its development and its influence upon other important branches of manufacture—affords more copious illustrations than any other of the immediate influence of pure science upon industrial progress. It therefore affords a topic which the chemist may well be excused for continually recurring to, with an interest bordering on enthusiasm, when illustrating the material advantages which accrue to communities from the promotion of scientific training and the encouragement of chemical research.

The iron and steel industry presents a great contrast to that of the artificial colours, in regard to the extent of influence which the labours of purely scientific investigators have exerted upon its development. The efforts of scientific men to unravel such problems as, for instance, the true chemical constitution of steel, or the precise differences between the various combinations known as cast-iron, and the conditions which determine their individual production or conversion from one to another, have hitherto been attended by results not at all proportionate to the patient experimental investigation of which from time to time they have been made the subject. Thus the protracted experiments and discussion carried on by Frémy and Caron some years back, with reference to the dependence of the characteristics of steel upon the existence in it of nitrogen, cannot be said to have led to results of a more conclusive or even definite nature, regarding the conditions which regulate the production, composition, and properties of steel than those arrived at by previous distinguished experimentors; and the same may be said, with respect to cast-iron, of such experiments as those carried on for several years by Matthiessen (in which I also took some part), under the auspices of the Association, with the view to eliminate many existing points of doubt regarding the chemical constitution of cast-iron, by preparing chemically pure iron and studying its combinations with carbon and other elements occurring in cast-iron.

The prosecution of purely scientific investigation may, therefore, of itself fail to bear *direct* fruit in regard to the development of new metallurgic achievements, or even to the elucidation of the comparatively complicated and numerous reactions which occur in furnaces, either simultaneously or in rapid and difficultly controllable succession, between materials composed of a variety of constituents in variable proportions. There can, however, be no question regarding the important benefits which have accrued from the application of chemical knowledge to the study, and the perfection of furnace-operations by those who happily combine that knowledge with practical experience and with the power of putting to the test of actual practice the results of reasoning upon an intelligent observation of the phenomena exhibited in such operations, and upon the data which chemical analysis has furnished. In the hands of such men, the scientific results arrived at by Karsten, Berthius, Bunsen, Scheerer, Percy, and other eminent investigators, acquire new value, and by them the fruits of the labours of the patient toiler at analytical processes meets with that appreciation which their solid and permanently valuable work does not always command at the hands of their numerous brother-workers in chemical science who follow the far more attractive paths of organic research.

Naturally, the brilliant results achieved from time to time by investigators in organic chemistry,—the rapidity with which, by those results, theories are established or

extended, types founded, their offspring multiplied, and their connection with other families traced and developed, —impart to organic research a charm peculiarly its own. This, and the general ease with which new results are obtained by the pursuit of methods of research comparatively simple in their nature and few in kind, have for many years not only secured to organic chemistry an overwhelming majority of workers—they also appear to have had a tendency to lead the younger labourers in the field of organic research to under-estimate the value and importance, in reference to the advancement of science, of the labours of the plodding investigator of analysis. Yet no higher example can be furnished of the patient pursuit of scientific work, purely for its own sake, than that of the deviser or improver of analytical processes, who, undeterred by failure upon failure, indefatigably pursues his laborious work, probing to its foundation each possible source of error, carefully comparing the results he obtains with those furnished by other methods of analysis, and patiently accumulating experimental data, till they suffice fully to establish the value and trustworthiness of the process, which he then publishes for the benefit of his fellow-workers in Science. Truly the results of such labours do not stand in unfavourable contrast, from whatever light they may be viewed, to those of the investigator of organic chemistry. It is not to be denied that the labourer at organic research may—so far as the analytical work which should fall to his share in the course of his investigations is concerned—be tempted to reduce this, the least attractive portion of his work, to within the smallest possible limits, and having, for example, by a boiling-point determination, or a single analytical operation of the simplest kind, such as the examination of a platinum-salt, obtained a numerical result approximating to that which his theory demands, may hasten on to the further development of his airy structure, possibly not without risk to its stability. Unquestionably there are instances of frequent occurrence, in the pursuit of a particular line of organic research, in which more is not required than the identification of a particular product by some such simple means as above indicated: it is certain, moreover, that the labours of the organic investigator also not unfrequently afford bright examples of indomitable perseverance under formidable difficulties; and this alone should constitute a strong bond of union between the worker in organic research and his brother-worker in analytical chemistry, if one did not already exist in the active interest which each—if a true lover of Science—must take in the work of the other.

It has been remarked by one of the most distinguished investigators, and at the same time one of the most brilliant lecturers and successful teachers of our time, that the contrivance of a new and good lecture-experiment may rank in importance with the preparation of a new organic compound, and it may certainly be said, with equal truth, that the elaboration of a new and good method of analysis may rank in importance with a good research in organic chemistry, in reference both to the part it plays in the advancement of science and to its influence upon industrial progress.

An excellent illustration of this is afforded by reference to the Proceedings of the British Association when it met in this town thirty-six years ago. In a letter to Dr. Playfair, Liebig—who took a very active part in the proceedings of the Association in the earlier years of its existence—reports that Drs. Will and Varrentrapp have devised an excellent method for determining the amount of nitrogen in organic bodies, "very exact and easily performed." He then describes, in a few lines, the process so well known to chemists, which not only has been and continues to be invaluable to those engaged in organic research, but which, as may be testified by such researches as those of Lawes and Gilbert, has borne a most important and indispensable part in the advancement of agricultural chemistry. It is, I believe, but an expression of the unanimous conviction of chemists to say that the achievements in analytical chemistry of such men as Berzelius, Heinrich, Rose, and Fresenius take equal rank with the brilliant researches and theoretical expositions of such chemists as Liebig, Laurent, Gerhardt, and Berthelot: and that, of all the important contributions to the development of organic chemistry which we owe to Liebig, there is none which has exerted so great an influence on the progress of this branch of chemical science as his beautifully simple method of organic elementary analysis.

Reverting to the industry of iron and steel, which, in regard to some of its most important branches, cannot fail to be a subject of special interest in Plymouth and Devonport, it is not difficult to demonstrate that the labours of the analytical chemist have exercised and continue to exert an important influence on the very considerable advance which has in recent years been made, and still proceeds, towards securing complete control over the quality and character of the products obtained. The epoch is well within the recollection of chemists of my generation when the British iron-master first awoke to the benefits which might accrue to him from an application of the labours of the analytical chemist in connection with iron smelting.

When the last great stride was made in the manufacture of cast-iron, by the introduction of the hot blast, the iron smelter was naturally led to seek profit, to the fullest extent, with respect both to the great increase in the rate of production of pig-iron attainable thereby, and to the economy achievable in regard to the proportions and characters of the materials employed in the production of pig-iron. But, after a time, the great falling off in the quality of a large proportion of the products of the blast-furnace, and the difficulties experienced in the production of malleable iron of even very moderate quality, aided by the great impetus to competition in respect of quality given by the first International Exhibition in 1851, directed the attention of our more enlightened iron-masters to the likelihood of their deriving important aid from chemical science, and more especially from the investigations of the analytical chemist.

Among the earliest to realise the importance of trustworthy and detailed information regarding the composition of the iron ores of the country was Mr. S. H. Blackwell, who, in presenting to the Royal School of Mines a very extensive and interesting series of British ores which he had collected with great labour and expense, for exhibition in 1851, placed at the disposal of Dr. Percy the requisite funds for engaging the services of competent analysts (Messrs. J. Spiller and A. H. Dick), who, under his direction, and with subsequent pecuniary aid from himself and from Government funds, carried out a very careful and complete examination of this series, the results of which have been of great value, for purposes of reference, to those actively interested in the iron industry. It was, however, the first connection of Messrs. Nicholson and D. S. Price, and of Mr. E. Riley, with two of the most important iron-works of this country, about a quarter of a century ago (*i.e.*, at the time when the above investigation was commenced), that marked, I believe, the commencement of systematic endeavours to apply the results of analytical research to the improvement and regulation of the quality of the products of our iron-works.

It is perhaps but natural that the primary object sought, by application of the knowledge of the analytical chemist, should have been to eliminate or reduce the existing elements of uncertainty in obtaining the most abundant yield of pig-iron capable of conversion into railway bar sufficiently good to meet the minimum standard of quality, and to reduce still further the cost of production of such bar-iron by utilising materials concerning the composition of which (richness in iron, &c.) the iron smelter was completely in the dark. The information accumulated by the analyst respecting the composition of the ores, fuel, and fluxes available at the works, and the composition of the pig-iron and slags or cinders, produced under varied conditions, in regard to materials employed and to the pro-

portions of ore, fuel, and flux used in the blast furnace, could not, however, exist long without exerting a marked beneficial influence upon the quality of iron produced, and generally upon the iron industry of the country.

Percy's invaluable work of reference on metallurgy furnishes abundant evidence of the scientifically interesting as well as practically useful nature of the results obtained at that time by the chemist above named, and others, working under Dr. Percy, with respect both to the elaboration of important analytical processes (in which direction Mr. Riley has continued to the present day to do valuable work) and to the elucidation of the reactions occurring in the processes of reduction and refining of the metal. It is needless to dwell upon the fact that the aid of the analyst has now long since become absolutely indispensable to the iron and steel manufacture, but I may perhaps be allowed briefly to refer to one or two recent illustrations of the indispensable part which analytical research has played, and continues to play, in the extension of our knowledge of the chemical reactions involved in the production of cast- and wrought-iron and of steel, and of the influences which the chief associates of iron, in its mercantile forms, exert upon its physical characters.

Among the many valuable communications made to that most important body, the Iron and Steel Institute of Great Britain, by men who combine great practical knowledge and experience in iron and steel manufacture with high attainments in mechanical science, and such knowledge of chemical science as ensures a full appreciation of its value at their hands, one of the most interesting and suggestive to the chemist, is that on the separation of carbon, sulphur, silicon, and phosphorus in the refining and puddling furnace and in the Bessemer converter, contributed to the *Transactions* of the Institute's recent meeting by Mr. Lowthian Bell, whose valuable investigations in connection with the iron industry are as interesting to the chemist as they are useful to the manufacturer. Mr. Bell has brought together the results of an extensive series of practical experiments on the treatment of different kinds of pig-iron of known composition, in the refinery, the puddling furnace, and the Bessemer convertor, and by comparing the results of analytical investigation of the products of those experimental operations with each other and with those of the materials operated upon, he has obtained valuable confirmation of the views already held by metallurgic chemists regarding the succession in which carbon, silicon, sulphur, and phosphorus are attacked when pig-metal is submitted to the above purifying processes, and the extent to which those foreign associates of iron are abstracted, or resist removal by the more or less thorough application of those several modes of treatment. He has also thrown new light on the reasons why the most difficultly assailable impurity, phosphorus, obstinately resists all attempts to effect even a slight diminution in its amount by application of the Bessemer treatment. The earnestness with which Mr. Bell wages war against this enemy of the iron master, in one of its most favourite haunts, the Cleveland district, not simply with the old British pluck which acknowledges not defeat, but systematically, on scientific principles, calling to his aid all the resources which the continual advances in applied mechanical and chemical research place within his reach, cannot fail to contribute importantly, if it does not of itself directly lead, to the complete subjection of this most intractable of the associates to which iron becomes linked in the blast furnace. Indications have lately not been wanting that the existence of phosphorus in very notable proportion in iron may not of necessity be inimical to its conversion into steel of good quality, and it may be that this element, which is now turned to useful account to impart particular characteristics to the alloys of copper and tin, is even destined to play a distinctly useful part in connection with the production of steel possessed of particular characters, valuable for some special purposes.

In the great development which steel manufacture has received within the last few years, one most prominent feature has been the production with precision upon a large scale of steel of desired characteristics, in regard to hardness, &c., by first adding to fluid cast-iron of known composition the requisite proportion of a rich iron ore (with or without the addition of scrap-iron) to effect a reduction of the carbon to the desired amount, concurrent with a refining of the metal by the oxidising action of the ore, and then giving to the resulting steel the desired special qualities by the addition of suitable proportions of iron compounds of known composition rich in manganese and carbon (Spiegeleisen and the similar product called ferro-manganese). The germ of this system of producing steel varieties of predetermined characteristics, exists in crucible processes like that of Uchatius, which have been in more or less extensive use for many years past, but it is to such invaluable arrangements as are most prominently represented by the Siemens-Martin furnace, whereby several tons of metal may be fused and maintained at a very high temperature with as little liability to change, from causes not under control, as if the operation were conducted in a crucible, that we are indebted for the very great expansion which the direct application of the analytical chemist's labours to the development of the steel industry is now receiving.

The production of steel upon the open hearth, to the elaboration of which Dr. C. W. Siemens has so largely contributed, since he first established the process at Llandore in 1868, has, in fact, become assimilated in simplicity of character and precision of results to a laboratory operation, and may be justly regarded as a triumph of the successful application of chemical principles and of the power of guidance and control afforded by utilising analytical research, to the attainment of prescribed results upon a stupendous scale, with an accuracy approaching that which the experienced chemical operator secures in the laboratory upon a small scale, under conditions which he can completely control. The production of steel by a large number of small separate operations in pots has now become supplanted with great advantage by the Siemens-Martin system of working at some of our largest establishments at Sheffield; this system has also secured a footing at highly renowned Continental works, which are formidable competitors with us in the manufacture of steel, such as those of Essen, Creusot, and Térrenoire. It is specially interesting to notice that, in the hands of those who, on the Continent at least, equally with ourselves, have learned to combine the results of practical experience with the teachings of chemical science, the facilities now existing for dealing in a single receptacle with large masses of fluid steel have greatly facilitated the application of chemical means to the production of *solid* masses of considerable size, thereby reducing, if not altogether dispensing with, the necessity for submitting large steel castings to costly mechanical operations, with the object of closing up cavities caused by the escape of occluded gas as the liquid metal cools. The success in this direction which appears to have attended the addition of silicon in combination with iron and manganese to the steel before casting, in preventing the formation of so-called *blow-holes*, and in contributing at the same time to the production of the particular character of steel required, bids fair to be of special importance in connection with the application of steel to the production of projectiles for use against armour-plates, as affording ready, and comparatively very economical, means of ensuring the production of perfectly sound castings, which, in compactness of structure will, it is asserted, compete successfully with carefully forged castings, and even with the magnificent material which Whitworth produces by submitting the fluid metal to powerful pressure.

The part which silicon plays, by its comparatively high susceptibility to oxidation, in promoting the production of sound steel castings is readily intelligible, but the functions of the manganese compounds, which are an indispensable adjunct to the Bessemer process, and the application of

which has become an integral part of steel manufacture, are still far from being thoroughly understood, and there is ample scope for chemical research, in co-operation with practical experiment, in the further study of the influence, not only of manganese in the production, and upon the properties, of steel, but also of elements such as titanium, tungsten, and boron, and of chromium, which exists associated in considerable quantities with iron in a very abundant Tasmanian ore, to which prominent attention has lately been directed. The achievements of the mechanical engineer have so facilitated the handling and perfected the means of production and the mechanical treatment of malleable iron and of steel, that the full advantage may now be reaped of any improvements of a chemical nature which may be affected in the production of those materials; and it must be a source of pride to the chemist to observe with what success the teachings of his science are being applied by practical men of the present day in the construction of furnaces capable of withstanding the high temperatures required for the production and working of iron and steel in large masses, and in combining the perfect consumption, and consequent great economy of fuel, with the attainment of those high temperatures, and with a thorough control over the character of the gaseous agents to which the fluid metal is exposed in the furnaces. I need not quote the names of those men who have already rendered themselves prominent by their services in this particular direction, but may refer, in special illustration of the results achieved by purely practical men, to the success in applying very simple furnace arrangements to the attainment of the above results which has recently attended the labours of Mr. William Price, a principal foreman in the Royal Gun Factories at Woolwich.

A few experiments made in the early days of the application of armouring to ships and forts appeared to demonstrate, on the one hand, that steel was quite incapable of competing with malleable iron, of even very moderate quality, as a material for armour plates; and, on the other hand, that the penetrative power of projectiles made of chilled iron upon the Palliser system could not be surpassed, or even attained with any degree of certainty, by projectiles of steel, produced at comparatively very great cost. But some recent results obtained on the Continent, and especially in the course of the important experiments instituted by the Italian Government at Spezzia, have afforded decisive indications that steel—the application of which to the construction of ordnance has since that time been very greatly extended—may now be looked to hopefully as capable of affording greater protection against the enormous projectiles of the present day than can be secured by proportionately large additions to the stupendous iron-armouring of the most modern ironclads, and also applicable, at a cost very moderate when compared with that of ten years ago, to the production of projectiles of large dimensions, superior in point of penetrative power, and of uniformity in this respect, to those of chilled iron, the difficulties in the production of which are very greatly increased by the formidable increase which has lately been made in their size. Promising results have also quite recently been obtained at Shoeburyness with a new system of applying steel in conjunction with malleable iron, by which a perfect union of masses of the two materials at one of their surfaces is effected by the aid of heat.

The superiority of soft and very homogeneous steel over wrought-iron of the best quality, in regard to lightness combined with strength and toughness, are leading to its very advantageous employment in the construction of a particular class of vessels for the Navy; and the perfect confidence which can be placed in the uniformity, in structure and strength, of steel of such character as is produced by the Whitworth system of manufacture, has greatly facilitated the production of air-chambers of small weight, but capable of being quite safely charged with sufficient air (under the pressure of 1000 lbs. on the square inch) to carry the Whitehead torpedo through water to a distance of 1000 yards in little more than a minute and a half.

Thus, the results of the recent development of stee industry, to which the labours of the chemist have not unimportantly contributed, give promise of exerting a great influence upon the resources of nations for defence and attack. Although the necessity for the continual expansion of such resources cannot but be deeply deplored, there can be no doubt that the problems which it presents, and the special requirements to which it gives rise, must operate, and perhaps as importantly as the demands created by peaceful industries and commercial enterprise, in encouraging the metallurgist, the chemist, and the engineer to continue their combined work in following up the successes, to the achievement of which the results of scientific research have greatly, though indirectly, contributed.

If it were necessary to add to the illustrations which Mr. Perkin gave in his address last year of the practical fruits of research in *organic* chemistry, I might be tempted to dilate upon the important results which have, especially during the last ten years, grown out of the discovery and study of the products of the action of nitric acid upon cellulose and glycerine. During the six years which have elapsed since I had the honour of bringing before the members of the British Association the chief points of scientific interest and practical importance presented by the history of those remarkable bodies, their application to technical and war purposes has been greatly developed. Nitroglycerine gun-cotton may now be justly classed among the most interesting examples of the practical importance frequently attained by the results of chemical research, while the history of the successive steps by which their safe manipulation and efficient application have been developed affords more than one striking illustration of the achievements effected, by combined chemical and physical research, in the solution of problems of high scientific interest and practical importance, and in the vanquishment of difficulties so formidable as for a time to appear fatal to the attainment of permanently practical success.

It is to a careful study of the influence which the *principal* character of gunpowder (its density, hardness, &c.), and its *mechanical* condition (*i.e.*, form and size of the masses and condition of their surfaces) exert upon the rapidity of its explosion under confinement, that we chiefly owe the very important advance which has been made of late years in controlling its explosive force, in its applications as a propelling agent, and the consequent simple and effectual means whereby the violence of action of the enormous charges now used in siege- and ship-guns is effectually reduced to within their limits of endurance without diminution of the total explosive force developed. But, concurrently with these important practical results, the application of combined chemical and physical research to a very extended and comprehensive investigation of the action of fired gunpowder, has furnished results which possess considerable interest from a purely scientific point of view, as in many respects modifying, in others supplementing, the conclusions based upon earlier experiments and theoretical considerations with respect to the nature and proportions of the products formed, the heat developed by the explosion, the tension of the products of combustion, and the conditions which regulate it, both when the explosion is brought about in a close vessel and when it occurs in the bore of a gun. The results of these physico-chemical researches have, moreover, already acquired practical importance in regard to the light they have thrown upon the influence exerted by variable conditions of a mechanical nature upon the action of and pressure developed by fired gunpowder in the bore of a gun, and in demonstrating that modifications in the *composition* of gunpowder, not unimportant from an economical point of view in dealing with the very large charges now employed, may importantly contribute to render the storing of the maximum of work in the projectile, when

propelled from a gun, compatible with a subjection of the gun to comparatively very moderate and uniform strains.

Other interesting illustrations of the intimate manner in which physical and chemical research are linked together, and of the important extent to which some of our most illustrious workers in chemistry have contributed to demolish the semblance of a barrier which existed in past times between the two branches of science, are furnished and suggested in the recently published Lists of Grants of Money which the Government has made to scientific men, on the recommendation of the Royal Society, from the fund which for the first time last year was added to the very modest sum previously accorded from national resources in support of research. The perusal of that list, representing as it does a most carefully considered selection by the higest representatives of science in the country, from a very large number of applications, affords important evidence on the one hand of the active pursuit of science in Great Britain, and, on the other, of the very wide range of subjects of interest and importance, the full investigation of which demands the provision of adequate resources. That the necessity for such resources needs but to be thoroughly made known to ensure their provision, even from other than national sources, has been demonstrated by the success which, in a comparatively brief space of time, has attended the efforts of the Chemical Society to establish upon the foundation patriotically laid by one of its original members, Dr. Longstaff, a special fund, to be administered by the Society, for the advancement of chemical science. An inspection of the list of contributors to this special fund in aid of chemical research, which in about two years has reached the sum of £4000, and from the proceeds of which the first applications for grants have recently been met, is suggestive of two observations. One is, that the proportion and amount of contributions hitherto received are comparatively small from the source whence the greatest support of such a fund may naturally be looked for, namely, from those who most directly benefit by the results of chemical research. It is to be hoped that there are many prominent representatives of the chemical and metallurgical industries in this country who still intend to give practical effect to their natural desire to aid in the advancement of chemical science, and to the appreciation which they can hardly fail to entertain of the usefulness of this fund. On the other hand, it is a matter well meriting special notice that a very prominent section of the contributors to the fund is composed of some of the most ancient corporate bodies of the City of London. Most welcome evidence is thereby afforded of the readiness with which the City Companies are prepared to respond to appeals for the substantial support of measures well calculated to promote progress in science. This evidence, and the combined action which they are even now contemplating for promoting the application of scientific research to the advancement of industry and commerce, by establishing an institution for technical education upon a scale worthy to serve as a monument of the true usefulness of wealthy corporations, must be cordially hailed as very substantial proofs that these representatives of our national wealth and commercial supremacy are entering upon a new sphere of activity which will more than restore their ancient prestige, by according them a new rank, more elevated than any which their civic importance could, in the past or future, confer upon them—a rank high among the chief promoters of our national enlightment.

Preservation of Wine.—Prof. J. Nessler.—Two parts per cent of salicylic acid are mixed with melted paraffin, and small chips of wood or linen rags are saturated with the mixture and thrown into the casks, where they kill the organisms which promote the formation of vinegar.—*Moniteur Scientifique.*

PROCEEDINGS OF SOCIETIES.

AKADEMIE DER WISSENSCHAFTEN, VIENNA.

June and July, 1877.

L. Ebler, "*Determination of Water in Silicates.*" The powdered mineral is mixed with sodic carbonate at 60°, placed in a platinum boat, and inserted in a well-dried porcelain tube. The latter is then heated in an ordinary combustion-furnace until the silicate is completely fused, and the expelled water is driven into a calcic chloride tube by a stream of dry air. The process has been thoroughly tested, and gives satisfactory results.

A. Bauer and H. Schuler, "*New Formation of Pimelic Acid.*" This acid can be prepared by the action of potassic hydrate and potassic cyanide on amylen-bromide.

S. Zeisel, "*Action of Sulphuric Acid on Acetylen.*" This reaction, according to Berthelot, causes the formation of an acetylen alcohol. The author shows contemporaneously with Lagermarck and Eltekoff (CHEMICAL NEWS, xxxv., 163) that no alcohol but croton aldehyd results from the reaction, and that the formation of the latter is due not to the acetylen itself, but to the presence of vinyl bromide as an impurity.

L. v. Barth and H. Weidel, "*Action of Hydrochloric Acid on Resorcin.*" The reaction yields two compounds, which are to be regarded as ether derivatives of resorcin. One results from the condensation of 2 molecules accompanied by the separation of 1 molecule H_2O. The other results from the condensation of 4 molecules, accompanied by the elimination of 4 molecules H_2O. The two are separated by means of the varied solubilities of the lead salts. Both are amorphous, dichroitic, and impart a brilliant fluorescence to alkaline solutions, a property serving as a reaction for resorcin. Fusion with potash yields resorcin. Oxidation causes the formation of small quantities of picric acid and isophthalic acid.

J. Puluj, "*On the Radiometer.*" The author has constructed a radiometer, in which four disks of mica, blackened on one side with soot, are attached to two immovable beams at right angles to each other, and enclosed by a cube consisting of mica plates, which is lightly balanced on a vertical needle-point. Experiment showed that the cube rotated in exactly the opposite direction from that in which the disks would have moved if they had not been stationary. This fact would tend to show that action and reaction exist between the movable and stationary parts of the radiometer, and hence that inner forces are the source of the motion. The experiment shows, also, that a gaseous medium is necessary for the transmission of kinetic energy from one portion of the apparatus to another. Meyer's explanation of the movement of the disks in the radiometer, as resulting from the friction of the air on their edges, must be false, for it would require the cube to move in the same direction as the disks.

J. Kachler, "*Compounds in the Camphor Group.*" Oxidation of camphor with HNO_3 yields, besides the known acids, camphoric acid, meso-camphoric acid, camphoronic acid, and dinitro-heptylic acid, four new compounds, hydro-oxy-camphoronic acid, $C_9H_{14}O_6$, crystallising well, and forming mono-, di-, and tribasic salts, and three acids of analogous composition. Mono- and dinitro-heptylic acids are changed by reduction into methyl-isopropyl-keton.

O. Zeidler, "*Substances Accompanying Crude Anthracen.*" The author describes those which are soluble in acetic ether. They consist of carbazol, phenanthren, fluoren, and two new hydrocarbons, pseudo-phenanthren, $C_{16}H_{12}$, and synanthren, $C_{14}H_{10}$. An easy method of separating carbazol from crude anthracen is described. The author has shown the formula of carbazol to be $(C_6H_4)_2NH$, by preparing the nitroso derivative—

$$\begin{matrix} C_6H_4 \\ | \\ C_6H_4 \end{matrix} > N - NO.$$

"*Action of Chloral Hydrate on Camphor.*" By rubbing together molecular weights of the two substances a clear liquid is obtained, which does not crystallise even at $-20°$, and is decomposed at once by water into the original substances. The specific rotatory power—10° less than that of camphor in various solvents—and other properties would tend to show it to be a molecular compound, and not a solution. Chloral ethylate acts in the same manner.

NOTICES OF BOOKS.

Fownes's Manual of Chemistry, Theoretical and Practical. Vol. I. Physical and Inorganic Chemistry. Twelfth Edition, Revised and Corrected by HENRY WATTS, F.R.S. London: J. and A. Churchill.

THIS work has since its first appearance been greatly extended and much modified, in accordance with the progress of research and the changes in theory. Only three editions were prepared by the author. The six following, edited by Drs. Bence Jones and A. W. Hofmann, were enriched with much important matter. The tenth and eleventh, as well as the present, are edited by Dr. H. Watts, whose name will be a sufficient guarantee for accuracy, and for a judicious selection of matter and for its convenient arrangement. The growing bulk of the subject has rendered essential a division into two volumes, the first of which, now before us, embraces chemical physics, and inorganic chemistry, while organic chemistry is the subject of the second.

Among the more important editions may be mentioned fuller descriptions of the rarer elementary bodies, and a more complete account of the characteristic reactions of the metals. The author's plan of describing first the non-metallic elements and their respective combinations, before entering upon the discussion of the main features of chemical philosophy, has been retained, though a brief account of the atomic theory is introduced immediately after the description of the compounds of oxygen. To attempt any formal examination of, or to search for errors in, a work upon which the chemical public has long ago expressed its opinion, and which has passed through the hands of editors of such unquestionable competence, would be a mere waste of time. The present edition, as adapted to the requirements of the day, will be no less favourably received than were its predecessors.

Year-Book of Pharmacy, comprising Abstracts of Papers relating to Pharmacy, Materia Medica, and Chemistry, from July 1st, 1875, to June 30th, 1876, with the Transactions of the British Pharmaceutical Conference at the Thirteenth Annual Meeting, held in Glasgow, September, 1876. London: J. and A. Churchill.

THE nature of this work may be correctly learnt from its rather lengthy title. The first portion consists of facts and discoveries in pharmacy, materia medica, as well as in chemistry, pure or analytical. It must be, of course, admitted that most of the contents of a yearly record closed nearly ten months ago most be already familiar to the scientific world. It appears, however, that the subject matter has been very carefully and judiciously selected.

The latter part of the work is devoted to the transactions of the Pharmaceutical Conference. This Society is by no means confined to pharmaceutists, but embraces many eminent chemists and others who have no professional connection with pharmacy, though interested in its progress.

There is an excellent general index, but an index of authorities quoted would be in our opinion a valuable addition.

The People v. *Daniel Schrumpff. Argument of W. P. Prentice, Counsel to the Board of Health, for the Prosecution.* New York: J. F. Trow and Son.

THIS pamphlet gives an account of a case of milk adulteration which seems to have excited considerable attention in the United States. The defendant, one Daniel Schrumpff, was accused and ultimately convicted of the very common sin of milkmen—dilution with water, and seems to have become a kind of representative man, the champion of the "Milk-Dealers' Association." The line of defence adopted was one with which we are already tolerably familiar in this country. It was attempted to show that natural milk fluctuates so greatly in its composition that its character, genuine or sophisticated, cannot be ascertained either by chemical analysis, by determination of specific gravity, or by any other method whatsoever. This doctrine, dear to the heart of every dishonest dealer, was insinuated to some extent before the last Parliamentary Committee on Adulteration, and produced there, as was intended, evil fruits. On the occasion here recorded it was signally refuted; the low-standard milk was an abnormal fluid, containing pus globules, and had been obtained from cows far advanced in pregnancy. The results of this case will be a "heavy blow and great discouragement" to sophistication throughout America, and its influence will doubtless be felt here also.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris,
No. 10, May 20, 1877.

On an Easy Mode of Preparing Crystalline Phosphorous Acid.—H. Grosheintz.—Trichloride of phosphorus, heated to 60°, is carried along by a current of dry air, the vapours being passed through two flasks, each containing about 100 grms. of water cooled to 0°. After the lapse of about four hours the contents of the first flask are saturated and converted into a thick crystalline paste. This is thrown upon a funnel plugged with asbestos, freed from the mother-liquor by means of the filter-pump, washed three times with very small quantities of water cooled to 0°, and dried in a vacuum.

Preparation of Alkaline Nitrites.—A. Etard.—The author reduces nitrates by means of the sulphite of potassium or sodium previously dried. Equal molecules of the two salts are melted in a crucible, and the mass, when cold, is pulverised and extracted with alcohol, which dissolves out the pure nitrite.

On a General Reaction yielding Compounds analogous to Chrome-Iron.—M. Gerber.—The author heats to redness, in a crucible, an anhydrous metallic chloride with potassic bichromate. The resulting mass is lixiviated with boiling water, and then treated with hydrochloric acid, in order to eliminate small quantities of metallic oxide which have not entered into combination. In this manner he has formed a considerable number of chromites.

Determination of Tin by means of Standard Solutions of Ferric Chloride or Cupric Chloride.—H. Pellet and A. Allart.—Reserved for insertion in full.

On a Method of Producing Tartronic Acid.—E Grimaux.—The author having caused baryta to act upon bibromated pyruvic acid, obtained tartronic acid, $C_3H_4O_5$, with its characteristic properties.

On a New Red Colouring-Matter accompanying Chlorophyll.—C. Bougarel.—Reserved for insertion in full.

Absence of Rotatory Power attributed to the Iodide of Triethyl-methyl-stibine.—J. A. Le Bel.—Already noticed.

Preparation of Nicotin.—W. Kirchmann.—Tobacco, previously steeped in carbonate of soda, is introduced into a wrought-iron vessel fitted with two tubulures. One of these receives a tube passing to the bottom of the vessel, and serves to convey a current of carbonic acid gas into the apparatus. The other receives a delivery tube for the escape of the gas, and plunges into a mixture of alcohol and dilute sulphuric acid. The whole is heated in the water-bath, the current of carbonic acid allowed to enter, the sulphuric liquid is treated with baryta, evaporated to dryness, and the residue treated with ether, which dissolves the free nicotin. The acid solution of sulphate of nicotin, if treated with hydrate of alumina, yields fine octahedral crystals of nicotine-alum (*Archiv. der Pharmacie*, xxxiv., 16).

Xanthate of Potassa used for the Determination of Sulphide of Carbon, Salts of Copper, and Caustic Alkalies, even in Presence of Alkaline Carbonates and Sulphuretted Compounds.—E. A. Grete.—Reserved for insertion in full.

"Plastic Crystal" of Dinas.—C. Bischof.—The substance so named is a variety of Portland cement remarkable for its plasticity, and consisting of—

Silica	86·42
Alumina	9·33
Oxide of iron	0·86
Lime	0·34
Magnesia	0·22
Alkalies	0·37
Loss on ignition	2·40
	99·94

—*Dingler's Polyt. Journal.*

Manufacture of Soluble Glass from Infusorial Earth.—F. Capitaine.—The author recommends infusorial earth, very plentiful in North Germany, as suitable for yielding silicate of soda, by treatment with a caustic lye at sp. gr. 1·2, under a pressure of three atmospheres. The soluble glass thus obtained is much richer in silica than that made from flints.

Moniteur Scientifique, Quesneville.
May, 1877.

Synthesis of Polybasic Acids by the Action of Carbonic Acid upon Salicylic Acid.—H. Ost.—The acids in question are the orthophenol-dicarbonic and phenol-tricarbonic.

Note on the Sewage of Paris.—C. Lauth.—The author finds that sewage saturated with air is not putrescible. By aëration the nitrogen of the insoluble portions decreases, whilst that of the soluble parts increases in the same proportion. There is no formation of nitrates, but the quantity of ammonia augments greatly. The hydrosulphuric putrefaction of sewage may be prevented by simple aëration.

Review of Physics.—R. Radan.—Under this title the author gives a series of compilations on the mutual relations of electricity and light; on a new method of determining the melting-pointe of various bodies (M. J. Löwe, in *Dingler's Journal*, cci.; Wolff, in *Archives de la Pharmacie*, iii.; and Prof. Himly, in *Poggendorff's Annalen*, 1877, No. 1); on a new syphon barometer (Bohn's, shown at the Loan Exhibition of Scientific Apparatus at South Kensington); on the absorption of rays of heat by watery vapour (M. Haga, in *Poggendorff's Annalen*, 1877); and on actinometric researches. In this last memoir the author gives an abstract of the investigations of MM. Bunsen, Roscoe, E. Marchard, Violle, and Crova.

Elements of Natural Vanillin.—MM. Tiemann and Haarmann.—An extract from the *Berichte der Deutschen Chemischen Gesellschaft*.

Extraction of Borax in California.—Taken from the *Bulletin de la Société d'Encouragement*, February, 1877.

Fixation of Indigo upon Tissues.—M. Prud'homme.—After giving a brief summary of the present methods of fixing indigo upon tissues, the author proceeds:—"We have recently discovered a new method of reducing and fixing indigo, which, without great practical value, presents nevertheless some interesting peculiarities. A mixture of glycerin, carbonate of soda, and protoxide of tin, in a paste, reduces indigo perfectly at about 120°. If water is used instead of glycerin the reduction is incomplete.

St. George's Hospital.—A short time since the death of Dr. Noad, F.R.S., was announced. Dr. Noad had held the Lectureship of Chemistry and Physics at the Medical School of St. George's Hospital for the space of thirty years. Among his contributions to science some of our readers will recollect his researches (now many years ago) "On Certain Compounds belonging to the Aromatic Series." He was also well known as an authority as to the value of iron ores. He was the author of "A Manual of Chemical Analysis," and of a work on "Electricity." His loss will be felt in many quarters. Professor Wanklyn has just been appointed Lecturer on Chemistry and Physics in the room of Dr. Noad.

CHEMICAL LABORATORY,
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Director—Prof. R. FRESENIUS, Ph.D.

LECTURES.

Experimental Chemistry (Inorganic), Prof. R. FRESENIUS, Ph.D.; Experimental Physics, Organic Chemistry, and Theoretical Chemistry, Prof. C. NEUBAUER, Ph.D.; Chemical Technology, H. FRESENIUS, Ph.D.; Botany and Zoology, Prof. L. KIRSCHBAUM, Ph.D.; Mineralogy, C. KOCH, Ph.D., State Geologist; Practical Instruction in the Laboratory, Prof. R. FRESENIUS, Ph.D., H. FRESENIUS, Ph.D., and two Assistants.

The next Session commences on the 15th of October. The Regulations of the Laboratory and the Syllabus of Lectures will be forwarded gratis on application to C. W. KREIDEL'S Verlag, at Wiesbaden, or to the undersigned.

Prof. R. FRESENIUS, Ph.D.

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THE CHEMICAL NEWS.

VOL. XXXVI. No. 927.

ON REPULSION RESULTING FROM RADIATION.—PART IV.*

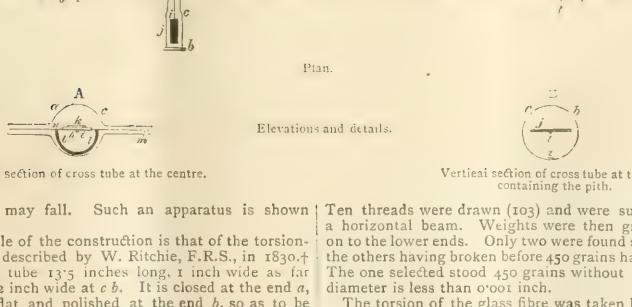
By WILLIAM CROOKES, F.R.S., &c.

(Concluded from p. 56.)

The Measurement of Force.

209. I have long endeavoured to devise some means of measuring the amount of force exerted by radiation, from a standard candle for instance at a foot off, on a measured surface of matter. The data given in pars. 199 and 200 are sufficient to enable the amount of force acting on the pith disks to be calculated indirectly; but I wished to have a means of measuring the force by as direct a method as we have of getting the weight of a ponderable body. I wanted an apparatus which will give me, at once, the pressure in grains which a ray of light exerts on a surface

FIG. 17.



on which it may fall. Such an apparatus is shown in fig. 17.

The principle of the construction is that of the torsion-balance first described by W. Ritchie, F.R.S., in 1830.† *a b* is a glass tube 13·5 inches long, 1 inch wide as far as *a c*, and 1·2 inch wide at *c b*. It is closed at the end *a*, and ground flat and polished at the end *b*, so as to be capable of being closed by a plate of glass cemented on. *d e* and *f g* are two narrower tubes sealed into *a b*, as shown, the part *d e* being 17 inches long, and *f g* 38 inches long. *d e* is ½ an inch in diameter, and is closed at the end; *f g* is a ¼ of an inch diameter. *h i* is a thin glass beam, having a glass weight at the end *h*, and a flat surface of lampblacked pith (*j*) at the end *i*. The pith (*j*) exposes exactly 2 square inches of surface. It is prevented from curling up in the vacuum by cutting it partly through at intervals, as shown. *k* is a silvered mirror, cemented on to the centre of the glass beam; *l l* are two knife-edges of glass, finely ground and polished; *m n* is a very fine fibre of glass cemented to the beam (*h i*) beneath the mirror (*k*). The end (*n*) of the glass torsion-fibre is attached to the solid stopper (*r*), which is carefully ground and polished into the contracted part of the tube (*s*). The other end of the torsion-fibre (*m*) is cemented to a filament of silk (*m o*); this silk is attached to one end of a steel spring (*p*), which is held firmly at the other end by the solid rod (*q*) cemented to the glass tube (*d c*). The torsion-fibre (*m n*) passes over the knife-edges (*l l*), which thus support the beam. The tension of the spring (*p*) is so adjusted that the glass fibre shall remain stretched under a constant pull of about 100 grains. *t t* is a circular card cemented to the end of the tube (*g*) and divided into 360 degrees. On the stopper (*r*) is fixed a pointer (*u*), which revolves with it, and marks the degrees through which it has turned. The complete revolutions are recorded on a "counter" (*w*). Motion is given to *r* by a torsion-handle (*v*). The apparatus is connected to the pump by the spiral (*x*), which works in a stopper tap (*y*) most ingeniously devised by my friend and assistant Mr. C. H. Gimingham, so as to enable the instrument to be disconnected from the pump and attached to it again without interfering with the exhaustion.*

The stopper (*r*) is very accurately ground and polished in the tube at *s*, as long a surface as possible being in contact. It should be lubricated by setting fire to a piece of plain india-rubber, and allowing the melted drops to fall on the contact surfaces. This is a nearly perfect lubricant, allowing very free movement and preventing any access of air.

210. The torsion-fibre must be selected with great care. Ten threads were drawn (103) and were suspended from a horizontal beam. Weights were then gradually hung on to the lower ends. Only two were found strong enough, the others having broken before 450 grains had been added. The one selected stood 450 grains without breaking. Its diameter is less than 0·001 inch.

The torsion of the glass fibre was taken by the method given in par. 186. With the weight of 15·46 grains hanging on to it half an oscillation took 30 seconds.

A fellow thread, selected of as nearly as possible the same strength and tension, and having a weight of about 100 grains at the end, broke when it was twisted 36 times. The actual thread used in the balance has been tested up to 30 turns without breaking.

211. A flat oblong piece of soft iron, weighing accurately 0·01 grain, is put loose into the cross tube under the pith surface (see *z*, fig. 17, vertical section of cross tube). This weight can be picked up by a horseshoe magnet outside the tube, and dropped on any part of the pith. A mark is made at the exact centre of the pith surface, and by moving the magnet about, it is easy to place the iron weight accurately on this mark.

212. A silvered glass mirror is supported at an angle of 45° over the pith surface, and so that the centre of the mirror is 2 inches from the pith when the beam is in

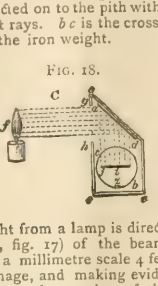
* A Paper communicated to the Royal Society, February 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

† *Phil. Trans.*, vol. 120 (for 1830), p. 215.

* I have asked Mr. Gimingham to send a description of this tap and some useful improvements he has introduced in the mercury-pump, to the Royal Society.

equilibrium. The whole is enclosed in a blackened box, in such a manner that when a candle is placed a few inches from the mirror in a horizontal line with its centre, no direct ray, but only the reflected ray falls on the pith. Fig. 18 shows the arrangement: *a d* is the mirror; *c c c c* is the wooden frame with the aperture (*g h*) in front to allow the flame of the candle (*f*) to fall on the mirror and thence be reflected on to the pith without illuminating the pith with direct rays. *b c* is the cross tube, *j* the pith, the beam, and *z* the iron weight.

FIG. 18.



213. A ray of light from a lamp is directed on the small central mirror (*k*, fig. 17) of the beam, whence it is reflected back to a millimetre scale 4 feet off, forming a sharply defined image, and making evident by its movement the slightest angular motion of the beam. When the reflected ray points to zero on the scale, it is evident that a turn of the torsion-handle (*v*) in one or the other direction will raise or depress the pith end of the beam, and thus cause the index ray to travel along the scale to the right or to the left. It is also evident that if a small weight is placed on one end of the beam so as to depress it, and the torsion-handle be then turned, the tendency of the glass fibre to untwist itself will ultimately balance the downward pressure of the weight, and (provided the glass torsion-fibre does not break) will bring the beam to a horizontal position, the index ray again pointing to zero. The object of the spring *p* is to keep the torsion-thread always stretched; and the silk fibre (*m o*) connecting the torsion-fibre and the spring is to allow the whole of the torsion of the fibre to be utilised in moving the beam, as the filament of silk may be considered practically free from torsion.

214. The first operation was to ascertain the number of degrees of torsion which were equal to the $\frac{1}{10}$ of a grain weight. The apparatus being well exhausted,* the index ray of light being at zero, and the pointer of the torsion-handle standing at 0° on the divided circle, the iron weight was picked up by a magnet, and placed exactly on the centre of the pith surface. The end of the beam instantly fell down, and I had to turn the torsion-handle 27 complete revolutions and 353° in addition, or 10073°, before the beam became horizontal and the index ray again stood at zero.† The downward pressure of $\frac{1}{10}$ of a grain was therefore equivalent to the force of torsion of the glass thread when twisted through 10073°.

215. My next operation was to find out the degree of delicacy of the balance. The law of torsion is that the force with which the glass fibre tends to untwist itself is directly proportional to the number of degrees through which it has been twisted.‡ I can therefore find out the smallest amount of weight which the balance will indicate by ascertaining what is the smallest angular movement of the torsion-handle which will cause an appreciable movement of the index ray of light.

I found that a movement of three degrees of torsion sent the index ray a considerable distance. One degree of torsion gave a very decided movement, whilst half a degree displaced the index ray to a sufficient extent to be easily seen. I believe less than half a degree could have been detected had the scale been further off; but not to run any risk of over-estimating the delicacy of the balance, I will take one degree of torsion as its ordinary working limit.

To what fraction of a grain will this torsion of one degree be equivalent? This is easily calculated. A twist through 10,073° balances the $\frac{1}{10}$ of a grain; a twist of 10,074° overbalances it.

10,073° : 0·01 grain : : 10,074° : 0·01000099 grain
∴ 10,074° − 10,073° = 0·01000099 grain − 0·01 grain,
∴ 1° = 0·00000099 grain.

The balance will therefore turn to the $\frac{1}{10000000}$ of a grain.

Divide a grain weight into a million parts, place one of them on the pan of my balance, and the beam is instantly depressed!

216. The balance was exhausted up to the highest point, the index ray of light was projected on to the scale, and the apparatus was kept in darkness, well protected from external influences by screens around it. The index ray soon became stationary; it was then brought to zero, and the pointer of the divided circle set to 0°, the counter also being at 0.

A standard candle was then adjusted 10 inches from the centre of the mirror, and therefore 12 inches from the surface of the pith. The screens were removed, and the reflected rays of the candle were allowed to fall perpendicularly on to the pith surface. The pith instantly sank to the bottom of the tube, and the torsion-handle had to be turned through 442° to restore equilibrium.

The $\frac{1}{10}$ of a grain required 10,073° of torsion to restore equilibrium (214); and the ratio between the weights being the same as that between the degrees of torsion, the mechanical force of the radiation from the candle is easily calculated:—

10,073° : 0·01 grain : : 442° : 0·00043 87 grain.

Other experiments were tried, the candle being blown out and the apparatus allowed to cool in the dark between each. The following Table gives the results:—

Mechanical Force of Radiation from a candle on 2 square inches of blackened pith.

Distance of candle from pith.	Degrees of Torsion.	Mechanical Pressure. Grain.	Difference of last column from mean. Grain.
12 inches	442°	0·000438	−0·000006
,, ,, ...	449	0·000445	+0·000001
,, ,, ...	452	0·000448	+0·000004
Mean	448	0·000444	
6 inches	1815	0·001801	+0·000029
,, ,, ...	1800	0·001787	+0·000015
,, ,, ...	1740	0·001727	−0·000045
Mean	1785	0·001772	
6 ins., with water-cell interposed	235	0·000233	

The pressure at 12 inches off is 0·000444 grain, whilst that at 6 inches is 0·001772 grain. At half the distance the pressure should be four times, or 0·001776 grain. The difference between theory and experiment, being only 4 millionths of a grain, is a sufficient proof that the indications of this instrument, like those of the previously described apparatus, follow the law of inverse squares.

The last column in this Table, the "difference from mean," shows that my estimate of the sensitiveness of this balance is not excessive, and that in practice it will safely indicate the millionth of a grain.

217. I have tried in vain to get a good observation with sunlight. On the very rare occasions within the last few months on which the sun has been shining brightly my balance has not been in adjustment, or I have been away from home. I was able, however, on December 13th last to get a few observations. The sun was obscured by

* This preliminary testing the value of the 1-100 grain weight can be equally well performed in air.

† This is the mean of several concordant experiments.

‡ Biot, *Traité de Physique*, tome i., p. 486. Ritchie, *Phil. Trans.*, vol. cxx., p. 215.

thin clouds and haze, and its rays were but faint. The pressure of its radiation was, on this occasion, only equal to that of 10·2 candles, six inches off, pressing down the pith, therefore, with a weight of 0·018074 grain.

218. But the result of my observations of the sun on Dec. 13th being only equal to 10·2 candles 6 inches off, is of course far below the real power of the unclouded mid-summer sun. I propose trying this experiment under more favourable circumstances. Meanwhile I have endeavoured to find what results in this direction have been obtained by other observers. The data given by different authorities vary considerably, as will be seen by the following Table :—

Baugee*	found that sun =	62,280	candles	1	metre	off.
Wollaston†	,, ,, =	59,830	,,	,,	,,	
Becquerel‡	,, ,, =	50,000	,,	,,	,,	
Zöllner§	,, ,, =	154,500	,,	,,	,,	

In these cases the sun was measured when at the highest point in a clear sky, and the *optical* difference alone was taken. In my case the light was very faint and hazy, and the total radiation, both of the sun and of the candle, was measured. I do not give my results as attaching the least importance to the actual figures, but simply as an illustration of the marvellous sensitiveness of the instrumental means at my disposal. I hope during the forthcoming summer to work out the subject more fully, and to be in a position to communicate to the Society many observations obtained with the torsion-balance, not only in photometry and the repulsion caused by radiation, but in other branches of science in which the possession of a balance of such incredible delicacy is likely to give valuable results.

POSTSCRIPT.—January 17, 1877.

In the foregoing paper, pars. 126, 128, 155, 156, 157, 158, 159, 170, and 171, experiments are referred to which show that the repelling force appears to be different on a white or a black surface according as the radiation causing the movement is dark heat (from the fingers, hot water, hot glass, or copper below 250° C.) or the luminous rays. In commenting on these results, I gave what appeared at the time to be the most reasonable explanation. Twelve months' research, however, has thrown much light upon these actions; and the explanation afforded by the dynamical theory of gases makes what was a year ago obscure and contradictory, now reasonable and intelligible.

In a preliminary notice submitted to the Royal Society, Nov. 16, 1876, and published in No. 175 of the *Proceedings*, I gave the explanation of the movements of repulsion under the influence of radiation according to the dynamical theory of gases, first, I believe, used in this connexion by Mr. Johnstone Stoney. In this preliminary notice I brought forward experimental proof that the presence of residual gas is the cause of the movement of the radiometer, and generally of the repulsion resulting from radiation, the maximum effect being at a pressure of about 50 millionths of an atmosphere. According to the dynamical theory of gases, the repulsion is due to the internal movements of the molecules of the residual gas. When the mean length of path between successive collisions of the molecules is small compared with the dimensions of the vessel, the molecules rebounding from the heated surface, and therefore moving with an extra velocity, help to keep back the more slowly moving molecules which are advancing towards the heated surface; it thus happens that though the individual kicks against the heated surface are increased in strength in consequence of the heating, yet the number of molecules struck is diminished in the same proportion, so that there is equilibrium on the two sides of the disk, even though the temperatures of the faces are unequal. But when the exhaustion is carried to so high a point that the molecules are sufficiently few and the mean length of path between their successive collisions is comparable with the dimensions of the vessel, the swift moving, rebounding molecules spend their force, in part or whole, on the sides of the vessel, and the onward crowding, more slowly moving molecules are not kept back as before, so that the number which strike the warmer face approaches to, and in the limit equals, the number which strike the back, cooler face; and as the individual impacts are stronger on the warmer than on the cooler face, pressure is produced, causing the warmer face to retreat.

This theory explains very clearly how it was that I obtained such strong actions in my earlier experiments when using white pith as the material to be repelled, and employing the finger as a source of heat, and how it happened that I did not discover for some time that dark heat and the luminous rays were essentially different in their actions on black and white surfaces. The explanation of this is as follows:—Rays of high intensity (light) pass through the wall of the glass vessel without warming it; they then, falling on the white surface, are simply reflected off again; but falling on the black surface they are absorbed, and, raising its temperature, produce the molecular disturbance which causes motion. Rays of low intensity (dark heat) do not, however, pass through the glass to any great extent, but are absorbed and raise its temperature. This warmed spot of glass now becomes the repelling body, through the intervention of the molecules rebounding from it with a greater velocity than that at which they struck it. The molecular pressure, therefore, in this case streams from the inner surface of the warm spot of glass on which the heat-rays have fallen, and repels whatever happens to be in front of it, quite irrespective of the colour of its surface.

* "Essai d'optique sur la gradation de la lumière, 1729, p. 30.
† *Phil. Trans.*, vol. 89, 1799.
‡ *Ann. de Chim. et de Phys*, 3 série, t. lxii., p. 34, 1861.
§ Private letter to the author.

ON THE COMPOSITION OF LIEVRITE, AS DETERMINED BY MR. EARLY'S METHOD.*

By J. EMERSON REYNOLDS, M.D., M.R.I.A.,
Professor of Chemistry, University of Dublin.

Of the several methods which have been devised for the analysis of ferroso-ferric silicates that which has been published by Mr. William Early,† Demonstrator of Chemistry in this Laboratory, is probably the most easily managed. The advantages attending its use are chiefly felt in analysing silicates, which are either insoluble in or attacked with difficulty by the ordinary acids; but it can also be used with great convenience in the analysis of silicates easily acted upon by acids. Lievrite is a silicate belonging to the latter class; and as the formula of the mineral is by no means definitely fixed, I requested Mr. Early to analyse by his method a portion of a particularly fine crystal which I obtained some time ago from the well-known Elba locality, our chief aim being to determine with precision the relative amounts of ferrous and ferric compounds present in the specimen.

The analysis was conducted in the following manner:—1·54 grms. of the finely and recently powdered mineral were mixed with 20 c.c. of hydrofluoric acid (containing 20 per cent of real acid), and the mixture was boiled for five minutes in a deep platinum crucible with a rather loosely-fitting cover: 10 c.c. of diluted sulphuric acid (1 part to 2 parts of water) were then added, and the boiling continued for a few minutes. The contents of the crucible were then washed into a flask with air-free water, and the amount of iron in the ferrous condition determined as rapidly as possible by standard potassic permanganate solution. Another quantity of the mineral was acted upon by strong hydrochloric acid; perfect decompo-

* Read before the Royal Irish Academy.
† CHEMICAL NEWS, vol. xxxi., p. 169.

action was effected, and a gelatinous mass formed; the product was evaporated to dryness, and the silica separated in the usual way. The acid filtrate from the insoluble silica was then saturated with chlorine gas, and ammonia afterwards added in slight excess; the mixture produced was then boiled in a closely-covered beaker in order to remove the excess of ammonia, the solution rapidly filtered, and the precipitate collected and ignited with the usual precautions, and weighed. The product contained all the iron as ferric oxide, the alumina, the manganese as Mn_3O_4, and a trace of silica. The silica was separated from this mixture by hydrochloric acid, and the filtrate was subjected to the double treatment with pure caustic soda for the separation of alumina. The iron and manganese were then separated by the baric-carbonate method. From the weight of iron thus found that previously ascertained to be present in the ferrous state was deducted; the difference represented the weight of metal in the ferric condition. The filtrate from the first precipitate caused by ammonia had the calcium separated from it as oxalate, and the latter was determined in the usual way; the filtrate from the calcium precipitate was then evaporated to dryness, and the residue heated to expel ammoniacal salts: the product of this treatment was dissolved with the aid of a few drops of hydrochloric acid, the magnesium separated by means of baric hydrate and estimated, while the alkalies in the filtrate were converted into chlorides and weighed, and the potassium separated by platinic chloride. No trace of lithium was detected in the mineral.

2·841 grms. of the freshly-powdered and unaltered mineral were heated gradually to redness in a hard glass tube connected with a weighed chloride-of-calcium tube; a current of dry air was at the same time slowly drawn through the apparatus. The water collected weighed 0·012 grm. = 0·422 per cent only.

The percentage composition of the specimen analysed by Mr. Early may be thus stated, when the metallic and other components are calculated as oxides:—

SiO_2	29·93
FeO	31·83
Fe_2O_3	20·16
MnO	3·02
CaO	13·71
MgO	0·30
Al_2O_3	0·36
K_2O	0·20
Na_2O	0·29
H_2O	0·42
	100·22

These data, when discussed in the usual way, give the following ratios:—

SiO_2	0·4983 = 3·85 = 4·00
RO	= 0·7431 5·74 = 5·96
R_2O_3	= 0·1294 = 1·00 = 1·04

or—

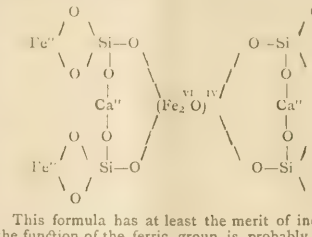
$$R_2O_3, 6RO, 4SiO_2,$$

where $6RO = 4(Fe,Mn)O + 2CaO$ nearly, neglecting the small amount of alkalies.

As the water present in the particularly pure specimen of the mineral analysed did not reach 0·5 per cent, it is difficult to admit, with Städeler, that it enters into the molecule of the compound; I therefore prefer to regard Lievrite as an anhydrous silicate.

Mr. Early's analysis of the mineral agrees in all essential particulars with those of Rammelsberg and Von Kobell, though both those distinguished observers found slightly more iron in the ferric condition. A comparison of the analyses of different specimens of Lievrite by Rammelsberg, Von Kobell, Städeler,* and Early, prove that there is little variation in the proportion of Fe_2^{VI} to Fe'': I am therefore disposed to regard the former as an essential constituent of the mineral, rather than as a product of the oxidation of a calcio-ferrous silicate. That the mineral oxidises in time there can be no doubt; but I have had a number of specimens of Lievrite under observation for nearly ten years, and though two of them were placed in a rather damp case they suffered comparatively slight superficial oxidation.

If, then, we admit that Lievrite is essentially a dicalcic ferroso-ferric silicate, we can assign to it the following symmetrical formula:—



This formula has at least the merit of indicating that the function of the ferric group is probably one of considerable importance, and that, so far from being regarded as an accidental constituent of the mineral, it ought to be considered one of the most important components of the molecule of the compound.

* See Dana's "System of Mineralogy," 5th edition, p. 296.

NOTE ON THE DOUBLE DECOMPOSITION OF POTASSIC BROMIDE AND SODIC CHLORIDE.

By J. H. BILL, Surgeon U.S. Army.

In the practice of analytical chemistry it is the custom, in arranging and recording the results, to associate the "strongest acid" with the "strongest base." Thus, if barium, potassium, sulphuric and nitric anhydrides are found in a compound, in the statement of the analysis we associate together the barium and sulphuric anhydride and the potassium and nitric anhydride.

In this record nothing is assumed, for the basic sulphate separates as an insoluble powder, the potassic nitrate remaining in solution a soluble crystalloid.

Again, if potassium, sodium, chlorine, and bromine are found in a mixture, we record the results as so much potassic chloride and sodic bromide; or if we mix solutions of potassic bromide and sodic chloride, we hold that potassic chloride and sodic bromide exist in the mixture in consequence of a double decomposition. On what do we rest such an assumption? Is it on anything more than analogy? The haloid salts of potassium and of sodium have nearly the same solubility and crystalline forms. We get no precipitate on mixing their solutions, nor characteristic crystals on evaporating these, nor change of colour in the solutions themselves, nor other evidence that the chemical relations of the several bodies have been altered. In short, our belief in this alteration is purely hypothetical.

Several years ago, while conducting a physiological research on the action of the bromides, I observed certain facts which I here offer as a demonstration of the proposition that potassic bromide and sodic chloride, when brought together in solution, undergo double decomposition.

If 5 or 6 grms. of potassic bromide are administered to a healthy man, his urine of the succeeding twenty-four hours will show the following changes:—Nearly all the potassium ingested as potassic bromide will be found in the urine in addition to that naturally present, united with

chlorine augmented according to the amount of bromide taken; the sodium scarcely altered in quantity; the sulphates and phosphates unchanged; only a very little bromine will be found. Bromides, however, may be detected for two weeks after the last dose taken, whilst excess of potassium will be found only after the first day.

I can account for these facts only on the supposition that the potassic bromide ingested was decomposed by the sodic chloride of the blood, potassic chloride—excreted by the urine—and sodic bromide—retained in the blood as a substitute for sodic chloride—resulting.

Further, this decomposition was the result of simple chemical affinity. We know of no instance where a "vital force" changes in the body the usual action of chemical force, and we have no right to assume it here. We hold the reaction, therefore, to be a universal one. I submit the average result of three analyses when no bromide was taken, and the average results of six analyses of urine when the body was under the influence of from 5 to 10 grms. of potassic bromide. The results show the amounts of the whole twenty-four hours, all the urine for that period being collected. The method was to incinerate a portion of the urine, and from the ash to separate the alkaline earths, sulphates, and phosphates. The sodium and potassium were then estimated in the form of chlorides by the indirect method. The chlorine and bromine were also estimated indirectly.

	Potassium. Grms.	Sodium. Grms.	Chlorine. Grms.	Bromide Grms.
No bromide taken	4·21	7·67	9·56	—
Seven grains (average) of bromide taken	6·52	7·82	11·45	0·04

I have waited for a chance to extend these experiments to the reaction of the iodides and chlorides, but seeing no probability that an immediate opportunity of doing so will present itself, I publish this note for what it is worth.—*American Journal of Science and Arts.*

ON CRYSTALLISED GRAPE-SUGAR.

By W. E. HALSE and J. STEINER.

In 1875 a cargo of starch-sugar was sent from England to Australia, but not having been accepted there it had to be brought back. On being offered here for sale it was found to be partially crystallised and to resemble cane-sugar, and it actually was taken for such. For this reason samples were sent to us for analysis, and in the following we give an account of this singular case:—

The received samples were of three different sorts—amorphous, amorphous with crystallisation on it, and others completely crystallised.

The amorphous substance, not differing in anything from common starch-sugar, is greyish white, and with stripes of brown passing through it. It feels dry, pulverulent, is hard, and slightly hygroscopical.

The second sample consisted of amorphous dark brown lumps, of a very pasty nature, with completely developed crystalline groups (rosettes) imbedded in it, and a yellow, very fine-crystallised, thin crust on some parts of the surface.

The rosettes are from the size of a bean up to that of a chesnut, and have a clear amber or pale yellow colour, with a fatty glance. The leaves in these rosettes resemble, in the outer part, front teeth, or wedges with spheric surface and sharp edges. By means of a knife these latter may be separated from the group without being broken. They seem a little harder than cane-sugar crystals, and are very brittle.

To free the rosettes from the adhering amorphous substance they were first immersed in dilute alcohol, then dipped in absolute alcohol, and subsequently dried with filter-paper. In this way we separated twelve to fifteen rosettes, weighing each from 4 to 5 grms.

The third kind of sample presented completely crystallised compact pieces, which were composed of either wart-like crystals or only of a very fine and dense crystallisation. They kept dry in the open air, were very hard, so as to require hammer and chisel to break them up, and on being ground a dry powder resulted (which is never the case with ordinary starch-sugar). By repeatedly and carefully dipping some lumps in dilute alcohol a part of the mass was dissolved out, and a network of the larger wart-like crystals of an amber-yellow colour was obtained, having the structure of a sponge and coral-like cavities. The pieces with the very fine crystallisation are of a much darker colour than the others, and could not be treated in a similar way without being completely dissolved.

We now give the results of the analyses of the crystals (rosettes and warts), and also of the original samples:—

CRYSTALS.

	Rosettes	Warts of the size of a Bean.	Warts smaller.	$C_6H_{12}O_6 + H_2O$, corresponding to —
Ash	trace	trace	trace	—
Water ..	9·45	9·26	9·45	9·09
Glucose ..	90·35	90·45	90·20	90·91
Dextrin ..	0·20	0·29	0·35	—
	100·00	100·00	100·00	100·00

SAMPLES.

	Amorph. with Rosettes.	Amorph. without Rosettes.	Fine crystallised.	Wart-like, small.	Wart-like, larger.	Amorphous.
Ash	0·30	0·37	0·35	0·29	0·15	0·45
Water ..	12·90	12·20	11·20	11·20	10·50	8·60
Glucose ..	80·10	79·00	81·40	84·67	85·00	83·90
Dextrin ..	1·74	1·40	1·53	0·79	0·68	1·54
Optic inact. subst. ..	5·80	6·95	4·94	3·12	3·67	5·51
	100·00	100·00	100·00	100·00	100·00	100·00

The amount of substance insoluble in water in these samples is only trifling.

The ash consists chiefly of gypsum.

The drying, which required much care and attention, could only be effected at about 90° C. A higher temperature causes the crystals to caramelise and decompose.

The melting-point of the rosettes is near 85° C., and that of the warts about 90° C.

For the determination of the optic active substances (glucose and dextrin) the polariscope, in conjunction with Fehling's solution, was used, which is the only reliable method.

Precipitation of dextrin by alcohol can only be of use as a qualitative test, and even then the gypsum and some of the intermediate products present may influence the test when only small quantities of dextrin occur.

In considering the results of the analyses of the samples with the wart-like crystals we observe that only an increase of sugar takes place with the growth of the crystallisation, and not of the other parts (water, dextrin, and intermediate products), which therefore in proportion seem to decrease. We may also assume that, if it were practicable to separate completely the adherent amorphous mass from the crystals, they would be found to represent pure grape-sugar.

That crystals in two distinct forms, and both equally pure, should have been formed, and as it seems under similar conditions, is very interesting.

The amount of free acid in these samples was also determined; it ranges between 0·06 and 0·01 per cent SO_3.

The darkening of the amorphous substance may have been effected by the combined action on partly caramelised products of moisture, lime, and of the ammonia liberated by the putrefaction of the albuminous matter (gluten) present. Caramel absorbs moisture more rapidly than

common starch-sugar. A long voyage in a tropical climate furnished not only the necessary conditions for the melting of the substance and for the development of ammonia, but was also favourable for such a slow crystallisation as grape-sugar requires. Once the crystallisation introduced, a continual growth took place.

Laboratory, 21, Mincing Lane

LABORATORY NOTES.*

By J. T. DUNN.

On the Retarding Action of Glycerin.

As suggested by Mr. Proctor at the last meeting, the action of a glycerin solution of iodine on iron was tried. Four cylinders were taken, and into each was put 25 c.c. of a solution of iodine in potassium iodine. They were then made up to 50 c.c., two with water and two with glycerin. A piece of iron wire was then placed in each; in two the wire was suspended near the surface of the fluid, and in the others it was placed at the bottom.

After a week it was found that the water solutions had been acted on much more rapidly than the glycerin solutions, the difference being most marked in the case of those in which the wire was at the surface.

In all the cylinders, however, the wire became covered with bubbles of gas, so that the protective action of the film of gas is not eliminated by using iodine. These bubbles were always larger and fewer in the water solutions than in the glycerin solutions.

A few days ago a corresponding set of cylinders were put up with bromine in place of iodine. Here the iron was rapidly attacked in the water cylinders, but the action in the glycerin cylinders appears to be complicated by other reactions, for the bromine in one is completely decolorised save at the bottom, and in the other the colour is paler than it was originally.

In this case, also, bubbles of gas were observed on the wires, larger and fewer in the water solutions than in the glycerin solutions.

On the Action of Ammonia on Sodium Phosphate.

When strong ammonia is added to a cold saturated solution of sodium phosphate, a white, crystalline, slowly-subsiding precipitate falls, the amount of which varies with the proportions of ammonia and phosphate used. It begins to be formed when the proportion of ammonia to phosphate is about 1 to 2, and the maximum amount is produced with about 3 volumes of ammonia to 2 of phosphate solution. The precipitate is readily soluble in water, but practically insoluble in strong ammonia.

Analyses made on the small quantities I have hitherto obtained rather tend to show that its composition is not constant; but I hope shortly to prepare and submit to analysis a larger sample.

NOTICES OF BOOKS.

Agenda du Chimiste, 1877, à l'usage des Ingénieurs, Physiciens, Chimistes, Fabricants de Produits Chimiques, &c. Paris and London: Hachette and Co.

THIS is an excellent little book, crammed with exact and valuable information for the chemist, physicist, and manufacturer. Like all French books of the kind, it is a model of what such books should be in the way of systematic arrangement. It is divided into three parts, the first consisting of physical and mathematical tables and data; the second relates to pure chemistry only; while the third is devoted to chemistry applied to manufactures. The first part is preceded by an almanack, which ought to give the days of meeting of the principal scientific societies of Paris, but oddly enough gives only those of the French Chemical Society. The body of the work naturally begins with tables of weights and measures, and their foreign equivalents. Here there is another omission, which can only be looked on as accidental, but which should be remedied in the next edition. We allude to the omission of English apothecaries' weight, although those of Austria, Germany, Russia, and several other countries are given. Following weights and measures we have copious thermometrical, dilatation, barometrical, and vapour tension tables. Next to these we have nearly a hundred specific gravity tables, some eighty of which give the exact amount of gases, salts, acids, and other soluble bodies contained in solutions of a given density. These tables cannot fail to be of great use to English chemists and manufacturers, who are so frequently puzzled to find the strength of solutions in French formulæ where the specific gravity only is mentioned. Receipts for freezing mixtures, boiling- and fusing-points, the indices of refraction, and rotatory powers of different substances bring us to Part II. It commences, of course, with atomic weights and volumes, followed by a very complete and succinct series of analytical tables, a special feature being a list of the spectra of the different elements, with the wave-length of each line. A series of factors for analytical calculations, with their logarithms, is next given, and the part ends with copious data with respect to volumetric analysis generally, acidimetry, and alkalimetry. The third part treats entirely of manufacturing chemistry, and is as full of valuable information as its predecessors. It opens with Clark's soap-test, and gold and silver assaying, and gives a number of methods for the commercial analysis of raw chemicals and other products (such as soda-cake, pearlash, manganese, chrome-ore, clays, soap, wax, &c.). The list of alloys, amalgams, and solders is very full, but electric amalgam has apparently gone to look for English apothecaries' weight, for it is nowhere to be found. A very useful table for the conversion of French chlorimetrical degrees into English, and *vice versa*, is also given. Urinometry follows in company with photography, and tables showing the general properties of animal, vegetable, and mineral colouring-matters; the whole concluding with a number of laboratory receipts for such things as lutes, indelible inks, and special reagents.

So far we have nothing but the highest praise to bestow on this little book; but we must now point out a very grave defect, which notably detracts from its value as a book of handy reference—it has no index. When a work of this kind is referred to it is generally in a hurry, and nothing is more galling than to have to hunt out a fact from a mass of other matter when a proper index would enable the student to hit upon it at once. It may be said that a work so systematically arranged as the present has no need of an index, but a single instance will suffice to show the fallacy of such an idea. While the book was waiting for review, the writer had occasion to refer to it to find out the amount of sodium hyposulphite contained in a solution of the strength of 20° Baumé, but had to look through nearly eighty tables before it could be found. Charles Lamb said that a good book without an index was like a chronometer without a dial—an acute remark, which applies most forcibly to the excellent little work before us. *Apropos* of this subject, it is somewhat strange that the French—who are so systematic in other ways—should ignore the use of indexes in so many instances. The two excellent treatises on *Physics* by Privat Deschanel and Ganot are rendered almost useless as works of reference by the want of an index, although as manuals for consecutive study they leave nothing to be desired. On the other hand, an index to a Dictionary would seem to some persons to be a work of supererogation, but

* Read before the Newcastle-upon-Tyne Chemical Society, March 22, 1877.

everyone knows the comfort and convenience of the indexes to Watts's *magnum opus*.

Inorganic Chemistry, adapted for Students in the Elementary Classes of the Science and Art Department. By Dr. W. B. Kemshead, F.R.A.S., &c. London and Glasgow: W. Collins, Sons, and Co. 1877.

We regret that we cannot say much in favour of this book. It is little more than a compilation from the popular manuals of Frankland, Miller, Roscoe, &c. The first named professor's "Lecture Notes" being drawn upon, with his leave the author tells us, somewhat largely. Dr. Kemshead, by way of gratitude no doubt, has adopted Prof. Frankland's old system of insectiform graphic notation with its rods and pegs. The author does not seem to be aware that Dr. Frankland himself has abandoned this method as being too cumbersome and confusing, and now uses simple letters and lines. The system of using thick letters for the supposed principal member of a group of elements too has, as far as we know, been given up by the majority of chemical teachers who had adopted it. It is somewhat curious, too, to see our old friends the atomicity marks appearing once more on the scene. We thought they had been buried in the Red Sea several years ago. The system of teaching, too, is one that we entirely dissent from. The author is far too fond of laying down a principle and then demonstrating or proving it by experiment, whereas the truly scientific and rational method is to perform the experiment first and then deduce the principle from it. A large number of experiments are described, but generally so meagrely that it would be impossible for a beginner to perform them. It would have been much better, for instance, to have fully described one or even two methods of making hydrogen than to have given some half-dozen ways of preparing this gas in too few words. The book undoubtedly contains an immense amount of information, and for anyone who wants to cram up chemistry by reading without bothering his head with fiddle-faddle experiments it is just the book.

Dr. Kemshead's book forms part of Collins's Elementary Science Series, but it is not at all on a par with others that we have seen belonging to the same set.

CORRESPONDENCE.

VOLUMETRIC ESTIMATION OF ZINC.

To the Editor of the Chemical News.

Sir,—In a former number of your journal (Chem. News, vol. xxxi., p. 222) I described a method for the volumetric estimation of zinc which seems to have met with some favour. I now add the following modification, which may be found useful in presence of some other metals:—Calcine the ore if necessary. Dissolve in hydrochloric acid. Let the solution cool, and neutralise with chalk. Add a solution of hypochlorite of lime, enough to peroxidise and precipitate any iron, manganese, copper, lead, cobalt, nickel. Filter, and wash the residue on the filter into a guaged flask. Take a measured sample; add about 5 to 10 per cent of strong hydrochloric acid. Boil till all free chlorine is expelled, and titrate the boiling solution with the ferrocyanide and uranium indicator, as before advised.—I am, &c.,

F. Maxwell-Lyte.

6, Cité du Retiro, Faubourg St. Honoré, Paris, August 15, 1877.

Fermentation-Products of the Refuse of Paris.—E. J. Maumené.—From some of the fermenting heaps the author has obtained alcohol and acetic acid, but from others hydrosulphate of ammonia, and even salts of compound ammonias.—*Comptes Rendus.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 4, July 23, 1877.

New Researches on Electro-Capillary Phenomena—M. Becquerel.—A continuation of the author's researches on the electro-chemical phenomena produced when two liquids capable of conducting electricity, and of reacting chemically upon each other, are separated by slits in glass tubes.

Fixation of Nitrogen upon Organic Matters, and Formation of Ozone under the Influence of Feeble Electrical Tensions.—M. Berthelot.—The author has observed the formation of ozone by four different reactions: the transformation of arsenious acid into arsenic acid, the conversion of iodide of potassium into iodate of potassa, the union of dry sulphurous acid and oxygen, and the formation of peroxide of silver in small quantities by the reaction of moist oxygen upon a slip of silver. This last reaction does not take place independently of electric action, and is attended with a cause of error which must be pointed out; the formation of black spots of silver sulphide formed at the expense of the small quantity of alkaline sulphide contained in the glass. Sometimes the simultaneous formation of silver sulphide at one point, and of silver peroxide at another, may be observed. They are easily distinguished by the aid of a concentrated solution of hyposulphite of soda, which dissolves in the cold the peroxide of silver without acting upon the sulphide. The fixation of nitrogen upon organic compounds takes place under the influence of five Leclanché elements, forming an open circuit. The reactions described are determined by very feeble electrical tensions, quite comparable to that of atmospheric electricity. These actions, however, are very limited, otherwise the humic matters of the soil would become rich in nitrogen rapidly.

Note on Dr. Bastian's Experiment on Urine Neutralised with Potassa.—M. Pasteur.—A continuation of the controversy on abiogenesis.

Electro-conductivity of Trees.—M. Th. du Moncel.—This paper contains an elaborate table of the resistance of different kinds of trees.

Reply to the Observations of M. Cosson on the Project of a Saharian Sea.—M. d'Abbadie.—An attempt to show that the submergence of the Sahara would be unattended with dangerous consequences.

Reply to the Observations of M. Naudin on the Interior Sea of the Sahara.—M. Roudaire.—This paper is similar in its character to the foregoing.

The Colorado Beetle.—M. Maurice Girard.—The author disapproves of arsenical compounds for the destruction of this insect, and recommends the sulpho-carbonate of potash in heavy doses.

Influence of Heat upon Magnetisation.—M. J. M Gaugain.—M. Favé had pointed out that when a bar of steel is magnetised at about 350°, allowed to cool, and heated again, the quantity of magnetism augments, and may reach triple the value which it had preserved after cooling. M. Wiedemann maintains that a bar magnetised at an elevated temperature loses on cooling a part of its magnetism: it loses a further portion when heated again, but on cooling it resumes a part of what it had lost. The author believes that this contradiction is due to the circumstance that M. Wiedemann experimented only with bars heated to 100°, whilst M. Favé operated with bars magnetised at a far higher temperature.

Magnetisation of Circular Plates where the Isodynamic Lines are Concentric Circumferences.—M.

E. Duter.—A mathematical paper, not suitable for useful abstraction.

Electrolysis of Sulphurous Acid.—M. A. Guerout.—It is supposed that on the electrolysis of aqueous sulphurous acid it is resolved into sulphur and oxygen, the sulphur appearing at the negative pole and the oxygen at the positive. The process, however, is by no means so simple. If the aqueous acid is decomposed by a feeble current the positive pole presents no visible change, but it may be shown by means of chloride of barium that sulphuric acid is produced. At the negative pole there appears a yellow liquid, which is the hydro-sulphurous acid of Schützenberger. If the intensity of the current is varied nothing is observed at the + pole but a production of sulphuric acid. At the − pole the product is modified. With two Bunsen elements, beside the production of the yellow liquid, there is a deposit of sulphur on the electrode, and with three the deposit of sulphur is complete, and a yellow liquor only appears at the outset. A solution of sulphurous acid, therefore, is decomposed like a salt, the acid and the oxygen going to the positive pole, and the hydrogen to the negative pole, where it reduces sulphurous acid to hydro-sulphurous acid, which latter, by its almost instantaneous decomposition gives rise to a deposit of sulphur.

Determination of Manganese, Nickel, Zinc, and Lead.—M. A. Riche.

Vapour-Densities of the Hydrosulphates of Ammonia.—M. A. Horstmann.—The author maintains that on mixing ammonia and hydrosulphuric acid, at temperatures from 50° to 80°, and in whatsoever proportion, there is no contraction.

Researches on the Gases contained in the Tissues of Fruits.—M. A. Livache.—In sound fruits contained in the tissues are formed of a mixture of oxygen and nitrogen in the same proportions as in the atmosphere. If the tissues are lacerated the oxygen is rapidly transformed into carbonic acid. If such fruits are left for some time a true fermentation sets in, and there is a plentiful evolution of carbonic acid, whilst the nitrogen undergoes no change.

Bulletin de la Societe Chimique de Paris,
No. 12, June 20, 1877.

Analysis of French Wines.—M. E. Houdart.—In determining the amount of solid residue in wines the author finds that four hours of desiccation, after the complete evaporation of 25 c.c. of wine, suffice to drive off all the water without incurring the loss of glycerin or of sparingly volatile ethers. If this time is exceeded the weight of the residual extract may be indefinitely diminished. The nature of the capsule is also of importance, whence comparable results can only be obtained by using in every experiment vessels of the same material and thickness. One and the same wine evaporated in a stout porcelain capsule gave 19·60 of residue, in a slender capsule 18·72, and in one of platinum 18·08.

Preparation of Fluosilicate of Ammonium.—M. F. Stolba.—The fluosilicic acid of commerce is digested with iron wire, and the solution evaporated until it deposits crystals on cooling. The boiling solution is then mixed with one-fifth its weight of a saturated and boiling solution of sal-ammoniac. The solution is let cool, the crystals are collected, washed with a little cold water, and recrystallised from boiling water.—*Archiv. der Pharmacie.*

Transformation of Oxalate of Ammonia.—G. Fleury.—A dilute solution of oxalate of ammonia, if preserved from the direct light of the sun, is completely converted into carbonate of ammonia in about six weeks. Hence this salt cannot be employed in the preparation of standard solutions. The oxalate of potassa is not much more stable.

Bronze for Iron.—M. P. Hess.—The articles to be bronzed are heated in the air after being coated with linseed oil. Objects which cannot be exposed to a high temperature may be steeped in a slightly acid solution of ferric chloride, plunged in hot water, and when dry rubbed with linseed oil or with wax. To preserve iron from rust the author recommends sulphide of copper. He steeps the iron for a few minutes in a solution of sulphate of copper, and then transfers it into a solution of hyposulphite of soda acidulated with hydrochloric acid. The result is a blue-black coating, not affected by air or water. *Deutsch Industrie Zeitung.*

Extraction of Copper by an Acid Solution of Ferrous Chloride.—M. A. Hauch.—To diminish the quantity of hydrochloric acid consumed in the extraction of copper from malachite, the author uses the acid solution of ferrous chloride obtained in precipitating copper from its hydrochloric solution by means of iron, as resulting from former operations.—*Oesterreich Zeitschrift für Berg. und Hüttenwesen.*

Extraction of Silver from Cyanide Baths.—M. de Bibra.—Baths of silver cyanide, the residues from galvanoplastic establishments, are precipitated with sulphuric acid. The precipitate contains all the silver along with copper, zinc, and iron. It is ignited, and the residue is treated with nitric acid, which dissolves out the silver, zinc, and copper. From this solution the silver is thrown down as chloride. The portion insoluble in nitric acid contains carbon, ferric oxide, and traces of silver, which may be extracted with ammonia.—*Journal für Praktische Chemie.*

Les Mondes, Revue Hebdomadaire des Sciences,
No. 12, July 21, 1877.

A shower of sand is reported to have occurred at Rome on June 22. It had the usual brick-red colour of the sands of the desert, and was accompanied with filaments and granules of pollen.

The electric light is being very successfully tried in the Palais de l'Industrie at Paris, the superficial extent of which is 12,000 square metres. The light proceeds from two electric lustres of six lamps each, suspended at the height of 20 metres from the ground. At least 10,000 candles would be required for an equal illumination of the floor alone.

No. 13, July 28, 1877.

This issue contains no original chemical matter.

No. 14, August 4, 1877.

Determination of Iodine in Mineral Waters.—M. Eboli.—The author's process is based upon the fact that the blue colour of iodide of starch disappears completely in presence of a chloride when the iodide is brought in contact with an alkaline hydrosulphate. The hydrosulphuric solution being previously standardised we may determine in this case all the iodine of a dissolved iodide. The mode of operating consists in causing the iodine to pass into the free state, which is effected by acidifying very distinctly a known quantity of the liquid under examination with a mixture of 1 part of nitric acid and from 4 to 6 parts of sulphuric, incorporating the whole with a little starch paste. If the reaction of the starch and the iodine does not appear in consequence of the very minute quantity of the latter in a dilute liquid, a fragment of peroxide of barium is added, when the liquid takes at once a blue colour. When the development of oxygen gas, from the decomposition of the barium peroxide ceases, a known volume of a standard solution of hydrosulphate of ammonia is gradually added, stirring the liquid well with a glass spoon, and suspending this operation as soon as the solution is decolourised. If there be present in the liquid under analysis iron, manganese, or any body other than iodine capable of reacting with hydrosulphate of ammonia, such must be previously removed. As for the graduation of the solution of hydrosulphate of ammonia, 1 grm. of iodide of potassium is dissolved in a burette of distilled water: the tube

being divided into 100 degrees, it is evident that 10 of these must contain $\frac{1}{10}$ grm. potassium iodide = 0·02356 grm. of pure iodine. A solution of hydrosulphate of ammonia is then made, as dilute as possible, say 10 c.c. of the commercial hydrosulphate in 250 c.c. of water. With this weak solution we make an experiment upon a decigramme potassium iodide, acidifying the liquid, adding starch-paste, and if needful peroxide of barium as above described, and then discharging the blue colour with the hydrosulphate solution. If, *e.g.*, 125° of this solution have been used, these must represent 0·02356 of iodine, the quantity contained in 1 decigrm. of potassium iodide. If we wish to analyse 100 c.c. of a mineral water containing an iodide, and if in the process we employ 80° of the standard solution, there must exist in the water 0·015078 grm. of iodine. If the iodine is combined with chlorine we take a further quantity of the liquid to be analysed, and precipitate both together by nitrate of silver in the ordinary manner. As we already know the quantity of iodine present in a given volume of the water, it is easy to deduct from the weight of the silver precipitate the increase of weight due to the iodide of silver. This difference gives the weight of the chloride of silver, from which the chlorine is calculated according to the formula Ag = 75·27, Cl = 24·73.

Falsification of Butter with Animal Fats.—M. P. Jaillard.—The author places a portion of the suspected sample between two suitable slips of glass, and examines with the microscope. If the product is pure fatty globules alone are perceived, but if it is adulterated arborescent crystallisations are perceived among the globules.

Moniteur Scientifique, Quesneville.
June, 1877.

Review of Physics.—M. R. Radau.—This very lengthy memoir contains no original observations, and is devoted to a history of thermo-actinometers, to the action of light upon plants, and to the sensitive layer of the retina. According to the researches of Pfeffer, light which has passed through a solution of chlorophyll exerts only a very feeble action upon vegetation. Such a solution transmits the yellow rays in great part, the green, and the extreme red, but absorbs the mean red.

Account of Foreign Researches in Chemistry.—M. E. Nolting.—The papers here abstracted are all taken from the *Berichte der Deutschen Chemischen Gesellschaft*, and have been already noticed.

Researches on Carbuncular Disease.—MM. Pasteur and Joubert.—A physiological paper. The authors hold that the part played in such diseases by bacteria, &c., has been greatly exaggerated.

Influence of a Solution of Potassa and of an Elevated Temperature on the Origin and the Development of Microphytes.—W. Roberts.

Behaviour of Alkalinised Urine.—Prof. Tyndall.—These two papers are taken from the *Proceedings of the Royal Society*.

Analysis of Pyrogenous Gases.—M. A. Berthelot.—Already noticed.

New Method of Determining Pure Anthracen in Crude Anthracen.—MM. Meister, Lucius, and Brüning.—A gramme of the anthracen to be analysed is placed in a small flask containing 500 c.c., and fitted with a reflux apparatus, covered with 43 c.c. of glacial acetic acid, and heated to a boil. This temperature is kept up, and a solution of 15 grms. of chromic acid in 10 c.c. of glacial acetic acid and the same volume of water is added drop by drop. This addition is extended over two hours, and when the whole has been poured in the liquid is still heated for two hours longer, the total process of oxidation thus requiring four hours. The contents of the flask are allowed to settle for twelve hours, mixed with 400 c.c. of pure water, and allowed to subside again for three hours. The anthraquinon which has separated out is collected on a filter, and washed first with pure water, then with boiling water rendered slightly alkaline, and then again with hot pure water. The contents of the filter are then washed into a small porcelain capsule, and dried at 100°. The dry anthraquinon is moistened in the same capsule with ten times its weight of fuming sulphuric acid, and heated for ten minutes in the water-bath. The solution thus obtained is poured into a flat capsule, and left for twelve hours in a damp place so that it may absorb moisture. At the end of this time 200 c.c. of cold water are added to the contents of the capsule, the anthraquinon which separates is again collected on a filter and washed as above, first with pure water, then with boiling alkaline water, and finally with pure hot water. It is then washed into a capsule, well dried at 400° (100° ?), and weighed. The capsule is then heated till the anthraquinon is completely volatilised, and is then weighed a second time with the ash and the residual carbon. The difference between the two weights gives the quantity of anthraquinon, from which the weight of pure anthracen is readily calculated.—*Zeitschrift für Analytische Chemie.*

Reimann's Färber Zeitung,
No. 28, 1877.

Detection of Turmeric in Flavin.—Flavin is now, it appears, often adulterated with turmeric. To detect this fraud a portion of the suspected sample is boiled with about twenty times its weight of water, the liquid is strained, and a bit of cotton yarn is plunged into the clear hot solution. If it takes a yellow colour turmeric is present, as flavin is very sparingly soluble in water.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following are the names of the Officers and Committee of Section B (Chemical Science Section) of the Plymouth Meeting of the British Association :—

President—F. A. Abel, F.R.S., Past President of the Chemical Society.

Vice-Presidents—Dr. Gladstone, F.R.S.; A. Vernon Harcourt, F.R.S.; Dr. Longstaff, F.R.S.; Prof. Odling, F.R.S.; W. H. Perkin, F.R.S.; Dr. Russell, F.R.S.; H. C. Sorby, F.R.S.; Prof. Williamson, F.R.S.

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The papers brought before the Section were as follows :—

W. N. Hartley.—Report of the Committee for Investigating Conditions under which Liquid Carbonic Acid Exists in Rocks and Minerals.

E. M. Dixon.—Report of the Committee for the Quantitative Estimation of Atmospheric Ozone.

W. H. Watson.—On the Action of various Fatty Oils on Copper.

J. Mactear.—On a New System of Alkali Manufacture.

A. H. Allen.—Report of Committee on Commercial Phosphates and Potash Salts.

Professor Barff. (Communicated by Dr. W. J. Russell.)—On the Formation of the Black Oxide of Iron on Iron Surfaces, for the Prevention of Corrosion.

Professor Gladstone.—On some Candles Altered by long Exposure to Sea Water.

T. Wills.—On the Coal brought home by the late Arctic Expedition.

Dr. C. Alder Wright.—Contributions to Chemical Dynamics.

James Mactear.—On a New Mechanical Furnace Used in the Alkali Manufacture, and for Calcining Purposes generally.

James Mactear.—Regeneration of Sulphur Employed in the Alkali Manufacture by the Mactear Process.

Dr. John Watts.—On Pyrocatechin as a Derivative of Certain Varieties of Tannic Acid.

A Vernon Harcourt.—On the Application of a New Unit of Light to the Examination of Coal Gas.

C. T. Kingzett.—Notes on Hederic Acid and Scammony.

C. T. Kingzett.—On Blood Albumen.

C. T. Kingzett and *Dr. P. H. Paul.*—On the Alkaloids of Japanese Aconite.

Dr. C. R. Alder Wright.—On the Aconite Alkaloids.

S. E. Phillips.—On the Constitution of Mellitic Acid.

S. E. Phillips.—On the Principle of Uric Acid Genesis.

Dr. Odling.—On some Properties of Gallium.

Dr. Odling.—Note on Benzine Derivatives.

Dr. Odling.—Note on Dr. W. Gibb's Researches on Cobaltamines.

Dr. D. C. Robb. (Communicated by Dr. Odling.)—On the Oxidation of Colophony.

J. M. Thomson.—Report on some Double Compounds of Nickel and Cobalt.

T. Fairley.—On Hydrogen Peroxide and some Uranium Compounds.

T. Fairley.—On the Thermo-Chemistry of Oxygen.

Sylvanus P. Thompson.—To Exhibit some Tables for Analysis.

P. Braham.—On the Explosive Character of a Mixture of Magnesium and Potassium Chlorate.

T. A. Readwin.—Note on some Recent Changes of Gold Surfaces.

T. A. Readwin.—On some recent Gold Pseudomorphs.

The meeting of the British Association for 1878 will be held at Dublin under the Presidency of Mr. William Spottiswoode, LL.D., F.R.S. The Vice-Presidents chosen are the Lord Mayor, the Provost of Trinity, the Duke of Leinster, Earl Rosse, Lord O'Hagan, and Professor Stokes. The meeting for 1879 will be held at Nottingham.

TO CORRESPONDENTS.

Mr. Allen and M. Kern.—M. Kern writes to say that as he is not very conversant with the English language most of his papers were written by another person, and errors may in this way have crept in. Bunsen may, as Mr. Allen states, have pointed out the probability of the existence of a new metal in the platinum group, but that does not prohibit him (M. Kern) from laying claim to the discovery of "Davyum."

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Classes conducted by the Professors and Lecturers of the College, and external Lectures are held during the Winter Months in nearly all the Arts and Science Subjects.

The NEXT SESSION will COMMENCE:—In the Arts, &c., Department, on the 2nd October; in the Medical Department, on the 1st October; and in the Evening Classes, on the 15th October.—Candidates for admission must not be under 14 years of age, and in the Arts and Science Department those under 16 will be required to pass a preliminary examination in English, Arithmetic, and Elementary Latin.

Prospectuses of the several Departments may be obtained from Mr. Cornish, Piccadilly, and other Booksellers in Manchester, and at the College.

J. HOLME NICHOLSON, Registrar.

THE CHEMICAL NEWS.

VOL. XXXVI. No. 927.

ON THE OCCURRENCE OF OXALIC ACID IN FUNGI.

By WILLIAM M. HAMLET, F.C.S., and CHARLES B. PLOWRIGHT, M.R.C.S.

THE object of the present paper is to record a few facts which came under the observation of the authors while engaged in the study of the part played by cryptogamic plants in the economy of nature.

These beautiful and interesting plants appear to be not only intermediate organisms between amorphous decaying vegetable matter on the one hand and the higher forms of vegetable life on the other, but are capable of serving as carriers of nutriment from one phase of plant life to another. Especially is this the case in the process of decay by oxidation termed by Liebig *eremacausis*, in which the existence of some fungi would appear to contribute in no small degree to render soluble compounds which previously existed in forms less easily assimilated. Thus it seems probable that the decay of the fungus effects a change which we may compare to that of the artificial manure manufacturer, whose object is to render soluble forms of matter which were previously insoluble.

As the varied and characteristic properties of different fungi became better known, no doubt by their effect on the human subject, they were generally classed into "poisonous" and "edible," but such a classification, by no means well marked, was very imperfect owing to ignorance of their properties.

Through the indefatigable labours of the mycologist we have become acquainted with their acrid nature, behaviour with tincture of iodine, decomposition, action of heat in cooking, which renders some of the so-called poisonous ones edible, and many other changes, not to mention several analyses which from time to time have appeared.

Greville in his "Scottish Cryptogamic Flora," vol. iii., plate 113, under *Polyporus sulphureus*, mentions the fact that Prof. Thompson found crystals of hydric potassium oxalate in a plant of this species, and Dr. R. Scott (*Trans. Linn. Soc.*, viii., 268) also discovered oxalic acid in the same species. And more recently De Bary (*Morph. und Phys. der Pilze*, pp. 13, 14) regards calcium oxalate as a common constituent of fungi.*

In the early part of last summer some fine specimens of *Peziza venosa*, Pers., were noticed by us to give a strong acid reaction to test-paper; on several other occasions both previous and subsequent we found a large number of Agarics and Polypori to be decidedly acid. Opportunities for further research were presented when during the summer and autumn a large number of *Hymenomycetes*† were found to have the same reaction in a greater or less degree, which in every instance was distinct and permanent. It was not, however, confined to the Hymenomycetes, for the Lycoperda, Peziza, and Sphæriæ gave a similar acid reaction.

The question naturally presented itself as to what free acid or acid salt could be so widely distributed in the fungus kingdom.

To solve this problem a number of species were exhausted with pure water, filtered, and the filtrate examined qualitatively for acids, whereupon in every case a marked reaction for oxalic acid was obtained. In solutions to which a few drops of dilute acetic acid had been added, or solution made alkaline by ammonia, upon the addition of some solution of calcium chloride, a fine white precipitate was produced, which, on drying, gently heating, and treating with hydrochloric acid, effervesced, liberating carbon dioxide. Argentic nitrate gave a white precipitate soluble in nitric acid; barium chloride gave also a white precipitate, entirely dissolved by dilute hydrochloric acid.

To the solution, made neutral with very weak ammonia, was added solution of auric chloride, and a finely divided precipitate of metallic gold was obtained. The presence of oxalic acid was therefore established beyond doubt.

From amongst a great number of experiments one of the most remarkable examples of strong acidity was that of *Fistulina hepatica*; having in this case been fortunate enough to possess a large supply of this fungus, an estimation of the amount of free acid present as well as a gravimetric estimation of the oxalic acid by the lime-process were alike desirable. Accordingly 14·3808 grms. of the *Fistulina* were taken and digested with pure water for twenty-four hours; the solution filtered and the residue washed with pure water until the liquid passing through ceased to show acid reaction.

To the clear and port wine-coloured solution was gradually added some decinormal solution of sodium hydrate, the final point of saturation being ascertained by very sensitive neutral litmus paper. The quantity of alkali required was 1·9 c.c. which corresponds to 0·01197 grm. of $H_2C_2O_4.2OH_2$, equal to 0·083 per cent of free acid.

In order to verify the result thus obtained by the process of alkalimetry, 50 grms. of the fungus were cut into small pieces by means of a platinum knife and thoroughly exhausted with pure water on two large filters in connection with a Bunsen pump. The filtrate, together with the washings, were reduced by evaporation to about 100 c.c., rendered alkaline by dilute ammonia, and solution of calcium acetate added in excess. The calcium oxalate was filtered and well washed, dried on a weighed filter at 100° C. until constant.

50 grms. gave 0·0455 grm. $CaC_2O_4.OH_2$, which, calculated to percentage, shows 0·078 per cent of oxalic acid. We have then:—

	Per cent.
By alkalimetry	0·083
By estimation as calcium oxalate (dried at 100°)	0·078

A complete analysis of this interesting plant was in progress, but from deficiency of material and loss by accident was wholly arrested, and is deferred for another opportunity. An idea of its composition may be gathered from the unfinished analysis.

Proximate Analysis of F. Hepatica.

Water			86·120
Volatile* constituents	Oxalic acid	0·08	12·984
	Fat	0·15	
	Woody fibre (cellulose)	2·03	
	Mycose		
	Extractive matter		
	Resin		
Mineral* constituents (ash).	Silica		0·896
	Ferric oxide		
	Lime		
	Magnesia		
	Potash		
	Phosphoric acid		
	Sulphuric acid		
	Chlorine		
			100·000

* Found qualitatively.

A large number of specimens were examined qualitatively, and we discovered the presence of oxalic acid or oxalates in the following species:—

* But beyond this we believe no suspicion existed in the minds of mycologists of the extent to which the free acid or its compounds were present in the group of cryptogams.

† All the Hymenomycetes on the table at the Woolhope Fungus Meeting, held at Hereford in October, 1876, were examined and found acid to litmus paper without exception.

Agaricus (Amanita) phalloides, *Fr.*
Agaricus (Amanita) rubescens, *Pers.*
Agaricus (Amanita) vaginatus, *Bull.*
Agaricus (Lepiota) procerus, *Scop.*
Agaricus (Clitocybe) maximus, *Fr.*
Agaricus (Clitocybe) laccatus, *Scop.*
Agaricus (Mycena) galericulatus, *Scop.*
Agaricus (Hypoloma) appendiculatus, *Bull.*
Lactarius rufus, *Fr.*
Lactarius torminosus, *Fr.*
Lactarius subdulcis, *Fr.*
Russula vitellina, *Fr.*
Cantharellus cibarius, *Fr.*
Cantharellus aurantiacus, *Fr.*
Panus torulosus, *Fr.*
Boletus luteus, *Fr.*
Boletus scaber, *Fr.*
Polyporus betulinus, *Fr.*
Polyporus rufescens, *Fr.*
Polyporus farinellus, *Fr.*
Fistulina hepatica, *Fr.*
Lycoperdon giganteum, *Batoch.*
Lycoperdon gemmatum, *Fr.*
Leotia lubrica, *Pers.*
Peziza venosa, *Pers.*
Peziza rutilans, *Fr.*

From these and other facts before us we conclude that all mature non-microscopic fungi contain oxalic acid either in the free state or in combination with the alkalies or metals of the alkaline earths. And although much has been done during the last few years upon the composition of fungi, yet it has been chiefly confined to their ultimate analysis or to the analysis of the ash; it is therefore hoped that these few notes upon the proximate compounds, which enter into their composition may not be without some interest to the scientific world.

NOTE.—We might here mention that we found oxalic acid in *Oxalis corniculata*; from the beautiful violet solution obtained by treating the stem and leaves of this plant with pure water, a very copious precipitate was obtained on adding solution of calcium chloride or acetate. Most of the text-books mention the fact that oxalic acid is found in the wood sorrel (*Oxalis acetosella*) *Rumex acetosa*, *R. acetosella*, common rhubarb (*Rheum*), as well as in many lichens.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A W. HOFMANN.

(Continued from p. 5.)

Manufacture of Sulphuric Acid. By ROBERT HASENCLEVER, Manager of the Stolberg Works.

THE hot gases from the pyrites kilns are often used for the concentration of sulphuric acid. In this case the leaden pans are placed above or behind the kilns or the sulphurous acid from the furnaces is passed into a lead tower filled with hard burnt bricks. The arrangement of pans upon the kilns has the disadvantage that if they leak the escaping acid destroys the furnace. It has repeatedly occurred that in cases of such construction the manufacture of sulphuric acid has had to be suspended at the end of the year, and the pyrites kilns entirely rebuilt. It is preferable to place the pans behind the furnace and to construct a subsidiary flue connecting the kilns with the chamber, so that if repairs in the pans become requisite the manufacture of sulphuric acid may still go on without interruption.

A much better utilisation of the hot sulphurous acid for the purpose of concentration is effected in Glover's tower, which was first introduced in England, and has been described in full by Lunge.* The so-called Glover's tower consists of a leaden chest 4 to 8 metres in height, and of 6 to 10 square metres in superficial extent. For the preservation of the lead it is lined internally with a layer of stones, and is filled with coarse fragments of sandstone or bricks. These materials must be so selected as to resist the action of hot sulphuric acid. Whilst the hot gases from the kilns enter from beneath they escape at the top in a cooled condition, and are conducted at once into the chambers. Sulphuric acid of sp. gr. 1·5 flows in constantly from above (either alone or simultaneously with the nitrous acid from the Gay-Lussac tower). It is distributed in the tower, comes in contact with the hot sulphurous acid, and escapes below at the sp. gr. of about 1·7. This admirable arrangement was quickly adopted in France and Germany, and has everywhere given satisfactory results. By the direct action of the hot furnace gases upon the sulphuric acid, as it occurs in Glover's tower, a powerful evaporation is effected; the sulphurous vapours arrive cooled into the chambers, where the sulphuric acid which evaporates in the tower is likewise arrested, add as the watery vapour which escapes is also conducted into the chambers there is an economy of steam. Occasionally it has happened that the Glover's tower has been charged with a material so powerfully attacked by the hot acid that the apparatus has been totally choked up and has ceased to act. Another evil involved in the application of Glover's system consists in the fact that no satisfactory arrangements can be made to arrest the flue-dust, since the gases would be too much cooled. Thus the flue-dust is conveyed into the acid, which thus becomes contaminated with iron. For the production of common salt-cake, to be afterwards converted into soda, for the manufacture of superphosphate, &c., the acid concentrated in Glover's tower is perfectly suitable. But the process is less to be recommended for the preparation of sulphuric acid for sale, or for use in the manufacture of salt-cake for the makers of white glass.

The Glover's tower not merely effects the concentration of the chamber acid, but also the denitrification of the acid from the Gay-Lussac tower as already explained.

The further concentration of the acid from 60° to 66° B. is sometimes carried on in vessels of glass, but more commonly in those of platinum. The author has not met with any accurate statements of the outlay for glass, fuel, and labour for concentrating the acid up to 1·840, but according to communications from English manufacturers the cost is considerably greater than for platinum vessels.†

Attempts have been made to render the process of evaporation in glass retorts continuous, but the results of the platinum apparatus are still more favourable. Scheurer Kestner‡ estimates the loss of platinum at 2 grms. per ton of sulphuric acid. In a letter to A. W. Hofmann he gives the details of the loss, and states that accurate observations have been made at Thann during three portions of time. From 1854 to 1856, when the sulphuric acid contained a small quantity of sulphurous acid, 1·92 grms. of platinum were dissolved per ton of sulphuric acid of sp. gr. 1·840. From 1856 to 1862 the chamber acid contained nitrous acid, and 2·52 grms. of platinum were dissolved per ton of acid at 1·840. From 1862 to 1866 sulphurous acid was present, and the amount of platinum dissolved was 1·05 grm. per ton of acid of the same strength.

The chemical works at Hautmont (Department Nord) procured in 1865 a platinum apparatus holding 150 litres and weighing 28,548 grms. In 1870 the apparatus was repaired in Paris, when 7891 grms. of platinum were used, but 6275 grms. of old platinum were allowed for, and the weight of the apparatus by the addition of 1616 grms. was increased to 30,164 grms. At the end of 1873 the ap-

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

* Lunge, *Dingl. Pol. Journ.*, cci., 341.
† See note below.
‡ Scheurer Kestner, *Comptes Rendus*, lxxiv., 1286.

paratus weighed 28,452 grms., showing a loss of 1712 grms. During nine years working 6796 tons of sulphuric acid of 1·840 sp. gr. had been prepared in the apparatus. The loss of platinum was therefore 0·252 grm. per ton of sulphuric acid. The apparatus cost 30,588·40 francs at 1050 francs per kilo. The repairs in 1870 cost 3439·95 francs, together 34,028·35 francs. The worn-out apparatus was sold at 810 francs per kilo. = 23,046·12 francs. The expenditure was therefore 34,028·35 − 23,046·12 = 10,982·23 francs, or per 1000 kilos. sulphuric acid at sp. gr. 1·800 1·616 francs, or about 1s. 3½d.

(To be continued.)

ON A WATER JET AIR-PUMP.*

By J. W. SWAN.

As a supplement to the communications which have been made to the Society during the present session on the subject of aspirators, I exhibit one more form of this useful little instrument. There have been proposed so many slight variations of the form of the water jet aspirator, all alike in principle, and many very nearly alike in form, that I really do not know precisely what amount of novelty there is in the jet now exhibited. But I know that many experiments have been necessary in order to arrive at the degree of perfection of action which is attained in this particular form. A very slight difference in the form of the jet greatly alters the result. You will observe that this jet differs from Mr. Procter's in being all made of glass, and of one piece of glass; therefore there is nothing to go wrong through the shifting of parts, and it is moreover producible at small cost.

It acts very rapidly, and with a head of water, such as the water-pipes usually supply, the mercury gauge quickly rises to 28½ inches.

It is of course applicable to all the uses to which Bunsen's filter pump is put, the regulator mentioned in Mr. Procter's paper being employed to govern the degree of exhaustion if necessary. I think it would also find a useful place in chemical works and in pharmaceutical laboratories, where comparatively small drying and evaporating operations requiring some approach to a vacuum are often carried on. I think its use might even be extended to almost all the lecture-table and class-demonstration experiments usually performed by the help of the common air-pump with the advantages of great saving of labour and in the cost of apparatus.

ON HARDENED GLASS FOR LABORATORY PURPOSES.*

By J. W. SWAN.

"To supply me with flasks and beakers, almost as resistant of the destructive agencies of fire and hard knocks as cast-iron." That was the attractive proposal made to me a few days since by the representative of a company now working M. de la Bastie's process for hardening or tempering glass. Samples were provided, not of flasks and beakers, but of other vessels that would sufficiently illustrate their properties. I immediately, and with great eagerness, gave myself up to experiments with some of the vessels. Some of them are here to-night, and are at the service of the members for the purpose of experiment. The result of my experiments are at least interesting. I found that even in a very thick basin water might be boiled, by means of a naked flame strongly playing upon it, without fracture; that the hot vessel might, without harm, be lifted off the stand with cold tongs and set upon a cold plate of iron; that altogether it bore an amount of ill-usage that was extraordinary. Then I thought I would subject it to a severer test; I therefore only partly filled the basin, and allowed the flame to play upon a larger surface of the glass than was covered by the liquid, so that the margin of the basin might be heated above the boiling-point. I did this with the idea that probably under those conditions the temper of the glass might alter or be destroyed where the glass was more strongly heated, and if it was destroyed, that fracture would almost certainly result. The agent of the company said no, but the fragments—the results of two experiments of exactly the same kind—say yes. The character of the fracture is worthy of attention; you will observe that the bottom, which was covered by the water, is broken in small pieces like hardened glass, and that the rim has broken in larger pieces with sharp-cutting angles—in fact, like ordinary untempered glass. Possibly tempered glass may in some instances prove useful in the laboratory—for the much-abused water bottle for example—but for general purposes of the analyst, in place of flasks and beakers of thin glass, the experience which I have so far had of it, makes me very doubtful of its utility.

* Read before the Newcastle-upon-Tyne Chemical Society, March 22, 1877.

SOME NEW ACID AMMONIUM SULPHATES

By PAUL SCHWEITZER, Ph.D.

In the course of an investigation into the methods of determining sulphuric acid, I subjected ammonium sulphate to various degrees of heat and noted the loss which it sustained by decomposition; certain regularities were thereby observed, which led me to determine the quantity of sulphuric acid in the products obtained, from which I deduce the existence of at least one new compound of ammonium and sulphuric acid.

Neutral ammonium sulphate, exposed to a moderate degree of heat, loses at first quietly and without effervescence, one-half of its ammonia; and then, with rising temperature and under lively effervescence, an additional fourth of ammonia and of sulphuric acid. In the former case the requisite temperature is a little higher than the boiling-point of mercury, and the mass of a pasty and viscous condition; in the latter case below incipient red heat, and the mass a thin mobile liquid in a lively state of effervescence; both conditions are easily observed and products obtained of a uniform composition; in fact, in the latter case, the mass may be cooled at any time before complete volatilisation, and furnish the salt in question. Both salts present, after cooling, crystalline masses of greater toughness but inferior hardness than melted potassium bisulphate, to which they bear a general resemblance; they absorb water but slowly, and ammonia from a dry atmosphere with extreme reluctance.

1. $(NH_4)_2.SO_4$, *Ammonium Sulphate.*—The salt employed was pulverised and dried at 100° C., and contained in 1·5081 gr. = 2·6728 grs. $BaSO_4$ = 0·9177 gr. SO_3 = 60·8514 per cent, and may be supposed to have been pure, as theory would require 60·6061 per cent of SO_3.

2. $NH_4H.SO_4$, *Ammonium Bisulphate.*—The previous salt was heated until the thick pasty mass ceased to give off ammonia, when it was analysed, yielding in 1·7930 gr. = 3·6130 grs. $BaSO_4$ = 1·2403 gr. SO_3 = 69·1746 per cent. It was then heated for fifteen minutes longer, when it gave on analysis in 1·9267 gr. = 3·9004 grs. $BaSO_4$ = 1·3390 gr. SO_3 = 69·4971 per cent. No change had taken place in the composition of the substance by the second heating, which is proof, I think, of the existence of a stable compound. The acid sulphate requires by theory 69·5652 per cent of SO_3.

3. $(NH_4)_2H_4(SO_4)_3$, *Biammonium Tetrahydrogen Sulphate.*—The remainder of the previous salt was heated higher, until effervescence set in and 3 grs. had been

volatilised off, it gave on analysis in 1·2159 gr. = 2·5681 grs. $BaSO_4$ = 0·8818 gr. SO_3 = 72·5224 per cent. The rest was heated a second time, until another 3 grs. had been volatilised, when the remainder was analysed, giving in 0·8637 gr. = 1·8353 gr. $BaSO_4$ = 0·6301 gr. SO_3 = 72·9530 per cent.

There is no difference in the two results, which agree closely with the percentage of sulphuric acid in a more acid ammonium sulphate, which if of the above formula, requires 73·1717 per cent of SO_3. There was no trace of sulphurous acid found in the salt.

The reactions, according to which the two salts are probably obtained, are these :—

1. $(NH_4)_4SO_4 = NH_4H.SO_4 + NH_3$.
2. $4(NH_4HSO_4) = (NH_4)_2H_4(SO_4)_3 + SO_4 + 2H_2O + N_2 + H_4$.

Of other analyses made of products obtained by the application of a lower degree of heat, I mention two more, which correspond to a salt of the formula $(NH_4)_4H_2(SO_4)_3$, which requires 66·2983 per cent of SO_3, without, however, having verified the existence of this salt by additional experiments. It occupies about the relative position to the preceding salt that neutral ammonium sulphate occupies to the ordinary bisulphate; these are the figures: 2·1739 grs. = 4·1934 grs. $BaSO_4$ = 1·4396 gr. SO_3 = 66·221 per cent. 1·4495 gr. = 2·8077 grs. $BaSO_4$ = 0·9639 gr. SO_3 = 66·499 per cent.

Ammonium bisulphate, placed under a bell-jar with a vessel containing water, increased in weight by absorption in the following ratio :—

1·3896 gr. NH_4HSO_4.

1·0439 ,,	= 3·159 per cent	after 24 hours.
0·1089 ,,	= 7·837 ,,	,, two days.
0·1307 ,,	= 9·981 ,,	,, three ,,

Another sample, placed in an atmosphere of ammonia, generated from a mixture of sal-ammoniac and slacked lime, increased in weight in the following manner :—

2·1251 grs. $NH_4H.SO_4$.

0·0024 gr.	= 0·113 per cent	after 24 hours.
0·0030 ,,	= 0·141 ,,	,, two days.
0·0038 ,,	= 0·179 ,,	,, three ,,

—*American Chemist.*

State University of Missouri.

ON THE DETERMINATION OF MANGANESE, NICKEL, ZINC, AND LEAD.

By M. A. RICHE.

The author has shown that copper may be determined with the greatest accuracy by the action of the battery in a nitric solution, and it is also by the electric current that he proposes to determine the four metals above mentioned.

I. *Manganese.*

(*a.*) If the liquid only contains this metal as a sulphate or nitrate it is submitted to the action of a Bunsen element, if the manganese is in small quantity, or of two elements. The operation is performed in a platinum crucible, placed in a water-bath at from 70° to 90°. The manganese is deposited in the state of peroxide upon the crucible, which acts as the positive pole; the negative pole is a spiral of platinum. When the manganese has disappeared from the liquid it is decanted upon a filter, which is washed and incinerated in the weighed crucible: 250 milligrms. of oxide are deposited in five hours. The separation would be slower in the cold, when three elements may be employed: 750 milligrms. are deposited in eight hours.

(*b.*) Manganese is determined quite as accurately in presence of copper, nickel, cobalt, zinc, magnesia, alumina, and alkaline and alkaline-earthy metals. The manner of operating in these various cases may be seen in the author's memoir. Manganese cannot be determined when accompanied with a large proportion of iron. The peroxide is reduced to a salt of protoxide, which remains in solution. In this case the iron is thrown down by carbonate of baryta, and the filtrate is then submitted to the current.

II. *Nickel.*

The author has frequently used the battery in the analysis of the ores of New Caledonia containing nickel, magnesia, and often copper and manganese. The nickel is generally determined by precipitation in an ammoniacal liquid, but the metal often carries down magnesia at the negative pole. This is got rid of by dissolving the deposit in nitric acid, expelling the latter by sulphuric acid, and exposing the liquid to the current from two elements, which precipitates the nickel in a state of purity.

III. *Zinc.*

(*c.*) The substance is dissolved in sulphuric or nitric acid, and saturated with ammonia, so as to re-dissolve the precipitated oxide, and acetic acid is added in excess. The solution exposed in the cold to the action of two elements gives a very adhesive deposit upon the negative pole, which is formed of a cylinder or a sheet of platinum, previously tared.

(*d.*) An assay of brass may be made in a few hours by this means. The liquid, hot, is submitted to the action of a single element, when the copper is deposited alone upon the negative pole. This is removed, the iron is precipitated in the liquid by ammonia, and in the filtrate the zinc is deposited as just described by two elements. One-tenth of a milligrm. is deposited in a few moments.

IV. *Lead.*

(*e.*) If this metal is alone in a nitric solution it is exposed, either cold or hot, to the action of one element. The peroxide of lead is entirely deposited in a very adhesive layer upon the crucible which forms the positive pole. The liquid is syphoned off without arresting the current, and replaced with water, which is decanted two or three times, and the tared crucible is dried at 110° and weighed. 400 milligrms. are deposited in five hours, and 2 grms. in one night. The lead from a liquid containing not more than one-fiftieth milligrm. may be distinctly seen precipitating upon the sides of the crucible.

(*f.*) Lead is determined with the same exactitude in presence of large proportions of silver, iron, zinc, nickel, cobalt, alumina, magnesia, and the alkaline earths and alkalies. The assay of bronzes, alloys ordinarily containing tin, copper, and small quantities of zinc, lead, and iron, becomes—when based upon the facts pointed out above—a rapid operation where three of these metals are determined without filtrations or evaporations by weighing a sheet of tared platinum. The metastannic acid having been separated, the copper and the lead are thrown down together by a single element, the iron is precipitated by ammonia, and the zinc is determined in the filtrate by the aid of two elements.

The author is at present occupied with the assay of German silver.—*Comptes Rendus.*

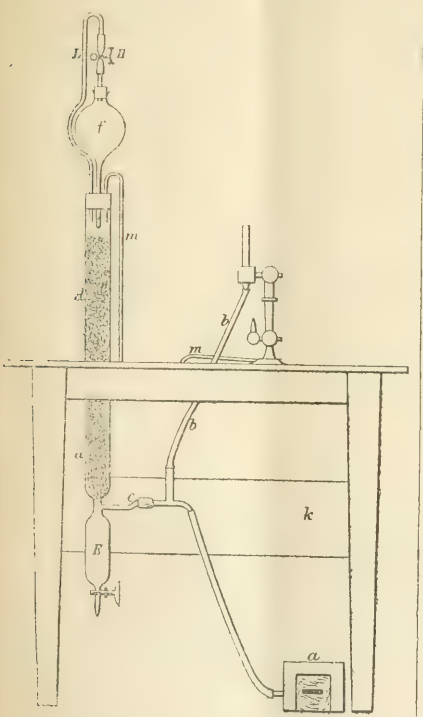
Proportion of Carbonic Acid in the Atmosphere.—Prof. Franz Farsky.—As the mean of 295 determinations the author gives the proportion of carbonic acid as 3·43 vols. in 10.000 of air. This figure is lower than those found by De Saussure and J. Boussingault, but higher than the results obtained by Schultze, Henneberg, Fittbogen, and Hässelbarth. The most numerous fluctuations were observed in November, December, February, March, and April, and the fewest in October. All meteorological conditions were registered along with each observation.—*Biedermann's Central-Blatt.*

GAS GENERATOR FOR USE IN CONNECTION WITH A BLOWPIPE.

By ALEX. C. THOMSON.

The following sketch of a gas generator for use in connection with a blowpipe will prove very serviceable in laboratories not supplied with gas.

a is an ordinary foot bellows; *b*, branch tube for supplying air to blowpipe; *c*, air tube leading into ditto; *d*, wide glass tube filled with pumice stone; *f*, reservoir containing a light liquid hycrocarbon, the lower tube being



drawn to a point and stuffed with a little sponge to allow discharge only by drops into *d*; H, clip for stopping discharge of liquid; L, tube to equalise pressure on both surfaces of liquid; E, reservoir to catch excess of liquid; M, tube leading off air charged with inflammable vapour; K, wooden support fixed to table.

A light mineral naphtha obtained from the coke towers of paraffin oil works is exceptionally suitable as a source of gas.

Those who can do a little glass blowing may construct the whole thing at a cost not exceeding three shillings, exclusive of the ordinary blowpipe fittings, and not inferior to a blowpipe supplied with coal-gas in the ordinary way.

Kincardine Castle, near Auchterarder,
July 30, 1877.

NOTICES OF BOOKS.

A Manual of Inorganic Chemistry. Vol. II.; the Metals. By T. E. Thorpe, Ph.D., F.R.S. Professor of Chemistry in the Yorkshire College of Science, Leeds. New Edition. London and Glasgow: W. Collins, Sons and Co.

Chemical manuals which present neither new facts nor original generalisations have been of late so numerous as to constitute the dread of the scientific reviewer. We must, however, assign a high place in its class to the work before us. We have found in its pages nothing which can be considered inaccurate, and it would be very difficult either to compress a greater amount of information in as brief a compass or to make a more judicious selection of matter. The rarer and more recently discovered metals are included in the plan of the work, and even gallium has received a notice, though not mentioned in the index or in the table of contents. The ores of the various metals, the places of their occurrence, the processes for their extraction, and their leading practical applications, are noticed, as well as their chemical and physical properties. The work is also abundantly illustrated with sketches of furnaces and other metallurgical plant, and with representations of crystalline forms.

The introduction, besides the usual exposition of the doctrine of elementary quantivalence, and well-written chapters on spectral analysis, on electro-chemical decomposition, and on crystallography, contains an exposition of Mendeleeff's law of periodicity, which is now evidently beginning to attract the attention which it deserves. There is also a brief but lucid explanation of the relations of chemical affinity to heat—a subject now becoming of great importance, yet often overlooked in books intended for the use of students. The classication adopted by the author is based upon their quantivalence, monads, dyads, &c. Arsenic he places among the non-metallic elements. We have always considered that both the Council and the Students of the Yorkshire College of Science are to be congratulated on their having secured the services of so sound and accurate a chemist as Professor Thorpe, and the present volume gives us no reason to alter our opinion.

New Observations on Hay-Fever, with New Experiments on the Quantity of Ozone in the Atmosphere. By C. H. Blackley, M.D., M.R.C.S. London: Baillière, Tindall, and Cox. Manchester: Tubbs and Brook.

Hay-fever, which many men of the old school consider as a mere imaginable malady, is now attracting much attention. The author examines the various theories formed to account for its origin, and pronounces that it cannot be possibly due to heat, to light, or to ozone, but is produced by the action of pollen coming in contact with the respiratory organs. He considers that 0·0000245 of a grain inhaled in each twenty-four hours suffices to bring on the malady in its mildest form. On the other hand, 0·00029 grain, or rather less than $\frac{1}{3447}$ of a grain in each twenty-four hours, will keep up hay-fever in its severest form. The author refers to an improved method of preparing iodised starch-papers for ozonometric purposes, and promises to explain the method of preparing it on some future occasion.

*Our Sun, from a Physical, a Philological, and a Mythological Point of View.** By Dr. Schmidt. Heidelberg: C. Winter. London: Trübner and Co.

This author considers it manifest beyond doubt that the sun is a cold body like our earth. Its rays only receive their luminous and calorific power when their rapid motion in space is arrested by the attraction of other heavenly bodies, such as our earth and its sister-planets. Light

* Unser Sonnenkorper nach seiner Physikalischen, Sprachlichen, und Mythologischen Seite hin Betrachtet.

he considers to be a liquid like water. He maintains that the amount of ozone in the atmosphere is connected with the decreasing proportion of its hydrogen and nitrogen, and that ozone and light increase simultaneously. Light and heat are produced by the combination of the hydrogen clouds of the sun with the ozone and the NH of our atmosphere. We must here remark that NH is a compound not yet shown to exist in our atmosphere, and further information concerning its properties would be welcomed by chemists. This same light and heat are, however, partially consumed (*verzehrt*, literally, "eaten up") by the nitrogen and hydrogen of terrestrial bodies. The earth also, it appears, gives off magneto-electric clouds of the composition HFe.

After having expounded these views in a few pages, the author adjourns to the regions of philology and mythology, where we must decline to follow him, and where some of our readers may possibly think he will be more at home.

Trade Report for April, 1877. By GEHE and Co., of Dresden.

A price-list of drugs and chemicals, with remarks on their relative consumption and production in different countries, and a prefatory essay on the general stagnation of trade and its causes.

An Architect's Letter about Sewer-Gas and House Drainage. By HENRY MASTERS. London: E. and F. N. Spon.

THE author describes and figures his method of protecting houses from the nuisance—often deadly and always offensive—of sewage-gas. It would be exceedingly difficult to give an intelligible description of his arrangements without the aid of the accompanying illustrations, but on careful examination we consider them eminently judicious. One point, however, he does not seem to notice. No sewer should be allowed to pass beneath the floor of a dwelling-house, but should strike out at once away from it. Thus, in closetted towns, the drains for the reception of sewage, properly so-called, would have to pass, not along the street, but along the gardens or yards at the backs of the houses.

Sanitas Sanitatum, et Omnia Sanitas. By RICHARD METCALFE, F.S.S. Vol. I. London: The Co-operative Printing Company.

THIS work contains much that is interesting and even valuable, much that is doubtful, and much that we cannot even take into consideration without wandering into regions where we might very probably figure to as little advantage as do our political contemporaries when they venture to discuss scientific topics. The author gives us his views on public baths and wash-houses, on the Turkish bath, on the recipients of medical charity, on small-pox, and on "dipsomania." We may remark that in treating of small-pox he strongly questions the value of vaccination. His argument is in substance this:—Every form of pestilence has periods of unusual intensity; and, again, intervals where it becomes rare, or even seems to die out altogether. A well-known instance in point is the plague, which, once so common in England, France, and Germany, has been unknown in Western Europe for a century and a half, and has been very rare even in its supposed cradle in South-Western Asia. Latterly, however, this fearful scourge has been reviving, and is taking year by year a wider sweep. Just in like manner, about the first part of the present century, small-pox seemed to die away, a result which was naturally ascribed to vaccination, then recently introduced. Since that time, however, in spite of the greater care taken in vaccination, and of its being made legally compulsatory, the disease has become more and more common, and has at times almost assumed the character of a pestilence. This statement, as far as regards the rarity of small-pox from 1820 to 1840 is, we believe, correct. The author considers that one pre-disposing cause of small-pox is the want of salt. But this cannot surely apply to a country where salt is so cheap as in England. He thinks that vaccination tends to check the increase of population. If this view is correct the political economists will urge the compulsory vaccination of every person at least once a year. But we doubt if facts will bear out this conclusion. In Germany population increases rapidly, and yet a double vaccination—once in infancy and once about the age of puberty—has been legally enforced there since 1835, if not from an earlier date. As to "dipsomania," we fear that if the drunkards are to be confined in palatial asylums at the cost of the ratepayers the remedy will be even more costly than the disease.

*What is Artificial Mineral Water? A Critical Examination of a Supreme Decision of the Royal Prussian Scientific Deputation on Medical Affairs at Berlin.** By Dr. HERMANN KOLBE. Leipzig: J. A. Barth.

IT appears that according to a law of the German Empire the preparation and sale of "liquid medicinal mixtures for external or internal application, with the exception of artificially-made mineral waters," is limited to the licensed pharmaceutical establishments (Apotheken). A manufacturer of mineral waters near Magdeburg, who though a qualified pharmaceutical chemist (zeprüfter Apotheker) was not the possessor of a registered shop, seems to have prepared not merely imitations of the waters of known mineral springs made up according to their analysis, but also analogous waters, which perhaps are not found flowing from any natural spring. By so doing he was held to have gone beyond the limits of the exception above quoted, and to have incurred a penalty. Prof. Kolbe contests the reasoning of the "scientific deputation," who pronounced that the preparations in question were not "artificial mineral waters," and he certainly seems to us to have the best of the argument. Had we in this country to contend with such minute and all-pervading legislation we should certainly complain of being too much governed.

Annual Report of the Scientific Club of Vienna.† 1876 to 1877.

WE have here an account of an establishment which fills us with wonder, not quite unmixed with envy. It offers to its members all the conveniences and attractions of a London Club, and much more, all for an entrance fee of five florins and an annual subscription of sixteen florins, which may be paid quarterly—this, it must be remembered, in a city where the cost of living cannot be pronounced lower than in London. The club, though only founded last year, numbers 640 members, and appears to be in every way flourishing. Among the objects of the club, in addition to its general purpose of serving as a medium for closer and more amicable intercourse among scientific characters and men of high culture, may be mentioned lectures, discussions and *conversazioni*, scientific excursions, assistance to scientific explorers by means of advice, letters of introduction, &c., even if material aid cannot be afforded; the friendly reception of foreign men of science, authors, artists, &c, who may pass through Vienna. In short, the club will possess, *en permanence*, many of the most desirable features of a meeting of the British Association during its week of existence. We wish the club prosperity, and imitators at home and abroad.

Report of the Commissioner of Agriculture for the Year 1875. Washington: Government Printing Office.

THE report of Mr. W. MCMURTIE, Chemist to the Department, is devoted to the influence of caustic magnesia

* Was ist Kunstliches Mineral Wasser? Kritische Beluchtung eines Oergutachtens der Koeniglich-Preussischen wissenschaftlichen Deputation fur das Medicinal wesen zu Berlin.

† Jahresbericht das Wissenschaft Club.

upon the vegetation of lime-soils; the proximate composition of two varieties of sugar-corn; the influence of arsenical compounds present in the soil upon vegetation; the influence of coal-gas upon the aërial portion of plants; the percentage of morphia in a sample of opium grown in Tennessee; the chemical composition of the mineral matter of cranberries: the composition of certain cave deposits found in the Southern States; and the percentage of tannin contained in various tanning materials.

Magnesian limes seem to have a peculiarly unfavourable effect upon light, sandy soils, first noticed by Sir H. Davy, and ascribed by him to the slowness of caustic magnesia in becoming neutralised by the carbonic acid of the atmosphere. In clay soils the magnesia forms a double compound with the silicate of alumina, and exerts no injurious action.

The action of arsenical compounds upon vegetation and upon agricultural soils has become an important consideration since "Paris green" has been extensively used for the destruction of the Colorado beetle and other insect pests. The following questions suggest themselves:—If applied to the soil can arsenic or arsenious acid be absorbed and assimilated by plants? If assimilated can it be taken up in quantity sufficient to become prejudicial to consumers? If not taken up by the plant during growth does it by its presence in the soil exert a poisonous action upon the plant? If so to what extent may it exist in the soil before it becomes injurious?

As regards the absorption and assimilation of arsenic Mr. McMurtie's experiments give a negative result. All the plants grown were examined by Marsh's test, and in no case was a trace discovered. Nor do arsenical compounds exert any injurious effect upon vegetation till the quantity present per acre reaches 900 lbs. for Paris green; 400 lbs. for arsenite of potassa; and 150 lbs. for arseniate of potassa.

The effect of coal-gas upon the aërial parts of plants—as distinct from the roots—was found to be destructive to vegetation. Camellias and other plants confined in an atmosphere containing from 1 to 2 per cent of coal-gas were killed.

The report of the Entomologist, Mr. Townend Glover, is also interesting. He has been especially engaged with an investigation into the habits of the *Hemiptera*, some of which are very destructive to vegetation, whilst others, being carnivorous, serve to keep the plant-feeding allies in check. *Dysdercus suturellus* not only sucks the juices of the cotton ball and seed, but depreciates the value of the fibre by voiding upon it an excrementitious yellow fluid of a colour not easily removed. It was once thought that this insect might afford a brilliant red tinctorial matter. Dr. Jackson, of Boston, however, only succeeded in obtaining from it a yellow dye, a pigment which he thought might serve as a basis for certain compound colours, such as greens and browns. But the supply of such dye-wares already far exceeds the demand. Several of the Hemiptera, when thrusting their rostrum into any living being, inject a poisonous fluid. The author considers the bite of the wheel-bug (*Reduvius novenarius*) as much more painful than the sting of a large wasp or hornet. In one case the flesh surrounding the puncture was so much poisoned that it sloughed off, "leaving a small hole in the injured thumb."

Reading this interesting memoir, and knowing what an important part for good or evil insects play in the productiveness of any country, we cannot help asking how it is that official entomologists are not carrying on similar investigations, if not in the home kingdoms, yet at any rate in India and in the tropical and semi-tropical colonies. Such an arrangement might easily effect a saving of millions to the empire. Perhaps, however, it is as well that the attempt is not made, as in the present humour of the nation the appointments would not be given to specialists like Thomas Edwards but to plausible sciolists of the "good all-round" type, who could "pass" in the laws and literature of Siam, in the interpretation of Egyptian hieroglyphics, in Araucanian theology, and in everything else that was utterly foreign to his prospective duties.

General Index to the New York Medical Journal, April, 1865, to June, 1876. (23 vols.) By J. B. HUNTER, M.D. New York: Appleton and Co.

A USEFUL and laborious compilation.

Design and Work: a Home and Shop Companion. Vol. II. London: G. Purkess.

THE appearance of this journal may doubtless be regarded as proof of an increased interest felt in applied science. Its columns are devoted to illustrated articles on elementary carpentry and joinery, the making and use of lathes, photography, telegraphy, metallurgy, technical chemistry, &c. There is a very extensive "Notes and Queries" department, a "Sale and Exchange" column, and an amount of correspondence which will certainly give the editor little time for dozing in his official chair. The information supplied to the readers of the paper, as far as we have had the opportunity of judging, is mainly correct and useful. Here and there an oversight slips in. Thus, in testing for nitrates in solution with protosulphate of iron and sulphuric acid, it is stated that if nitric acid is present a *green* cloud will be formed round the fragment of copperas thrown in. The colouration produced will be not green but of a reddish brown. The subject matter of the journal is not, however, by any means limited to technology, since we find notices of two theological works, papers on the future of the Drama, the women of Ancient Athens, the City Companies, &c. We notice that several correspondents complain of unfairness in the management of the late Centennial Exhibition at Philadelphia. If we may suggest we should certainly say that the insertion of "paragraph advertisements" of proprietary medicines scarcely suits the dignity of a scientific journal. Upon the whole we may wish *Design and Work* success, as calculated to let in the light of science in quarters hitherto but scantily illuminated.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 5, July 30, 1877.

Consequences deduced from Experiments made on the Action of the Gaseous Products of Dynamite with reference to Meteorites, and to various circumstances of their Arrival in the Atmosphere.—M. Daubrée.—The author compares the effects produced upon zinc and iron by the gases generated on the explosion of dynamite with certain peculiarities of meteorites, and traces a very close similarity.

Observations on Chemical Equivalents compared with Corpuscular Elements.—M. A. Baudrimont.—The author holds that if the chemical elements belong to a positive part of the science they are insufficient to characterise its progress, for being invariable they cannot represent all the ponderable modifications which bodies may undergo. If molecules escape from direct observation, their existence is nevertheless revealed to us by a totality of properties of the highest order. They are in harmony with chemical proportions, with the laws of Gay-Lussac and Avogadro, of Dulong and Petit, of Neumann, and those which the author has formulated, and, moreover, with isomorphism, polymorphism, allotropy, and all the fundamental properties of bodies.

Separation of Iron from Chrome and Uranium.—M. A. Ditte.—The separation of these metals presents certain difficulties. If we treat the substance under examination with oxidising agents, so as to make the chrome pass into the state of an alkaline chromate, either in order to determine the chromic acid as mercurous chromate, or with a view to reduce the chromate with hydrochloric acid and alcohol, precipitating the sesquioxide of chrome afterwards by means of ammonia, we necessarily introduce alkalies which it is difficult to get rid of, and whose presence may be inconvenient in the course of the analysis. As for the method of separating chromic oxide, by means of its solubility in cold potassa, it must be regarded as giving results scarcely even approximate. In like manner the separation of uranium by carbonate of ammonia, which ought to dissolve it entirely as uranate of ammonia, is not easily completed. We succeed better if, after having precipitated the oxides by ammonia, and having calcined them in a current of hydrogen, we treat the residue with dilute hydrochloric acid. The iron may be thus removed, but the protoxide of uranium is not perfectly insoluble in this acid unless it has been very strongly ignited. It is then washed, dried, and re-ignited in a current of hydrogen before weighing. The separation of these oxides may be effected with great accuracy by operating in the manner proposed by M. Sainte-Claire Deville for the separation of iron and alumina. The metals are brought to the state of sesqui-salts; all metals whose sulphides are insoluble in dilute acids are removed by known methods, and the ferric, chromic, and uranic oxides are then precipitated together by an excess of ammonia. Care must be taken to drive off by ebullition any free ammonia which might dissolve a portion of the latter. The oxides are well washed, calcined, placed in a porcelain tube, and heated to redness in a current of pure hydrogen. The ferric oxide becomes metallic iron, the uranic oxide (a mixture of U_3O_4 and U_4O_5) is reduced to UO, while the chromic oxide remains unaltered. This mixture of iron, uranium protoxide, and chromium sesquioxide is weighed, returned to the tube, and submitted to the action of a current of gaseous hydrochloric acid at a red heat. The oxides of uranium and chrome remain entirely unattacked by the acid, and their weight suffers no variation. As for the iron, it is entirely volatilised as ferrous chloride, and deposited in white crystals in a cooler part of the tube. After an hour or an hour and a half the boat is allowed to cool in a current of hydrogen intended to drive out the hydrochloric acid from the tube, and the mixture of chromic oxide and uranous oxide is weighed, and treated with pure nitric acid. The protoxide of uranium which remains in the form of a brown amorphous powder is at once attacked, even in the cold, with evolution of nitrous fumes and formation of uranium nitrate. It is well, however, to heat for a few moments in order to be certain that the chromic oxide retains no traces of uranium; the solution is then filtered off, and the residue calcined and weighed.

Certain Properties of the Sulphides of Platinum considered from an Analytical Point of View.—M. J. Ribau.—Platinic sulphide, prepared either in the cold or at the temperature of the water-bath, and taken alone—or at any rate in the absence of the metals of the first two groups—may be considered insoluble in the ammoniacal sulphides and the alkaline mono- and polysulphides. It may be placed in the second group along with mercury. Considerable quantities of platinic sulphide may be dissolved by means of well known artifices, such as pouring a solution of platinic chloride drop by drop into a sulphide, or melting a mixture of platinic sulphide and dry alkaline sulphides at redness. Platinic sulphide may be dissolved in ammoniacal sulphides and alkaline polysulphides in presence of metals of the first group, and in quantities the greater the more such metals are present. Platinic sulphide mixed with all the metals of the second group is not dissolved by ammonium monosulphide, but by the trisulphide, though less than copper. Platinous sulphide, according to its physical condition and the nature or degree of sulphurisation of the solvent, may be considered as either almost insoluble or as soluble. But the platinous salts are rarely met with in analysis, and can be readily converted into platinic compounds. The presence of platinum in the first group, to which it does not seem to belong, seems due to the common phenomena of entanglement. From the point of view of practical analysis, platinum should be sought for in the first group, and especially in the second, where it may be found entirely or in great part along with mercury. The detection of the metal in the first group has been already pointed out by authors: to find it in the second the sulphides of the second group must be treated with boiling nitric acid diluted at most with an equal volume of water. Sulphides of mercury and platinum remain unattacked; when dry they are introduced into a small sublimation tube. On heating we obtain a volatile ring, sulphide of mercury, and a fixed residue, sulphide of platinum. We separate these two parts by breaking the tube, and dissolve the mercurial ring in *aqua regia*. The fixed residue is roasted a few moments to convert it into metallic platinum, and is then dissolved in *aqua regia*.

New Method of Transforming Camphor into Camphen.—M. J. de Montgolfier.—The camphor after fusion is treated with sodium at a gentle heat.

Note on Certain Compounds of Titanium.—E. Wehrlin and E. Girard.—Not suitable for abstraction.

Determination of Potassa.—M. A. Carnot.—Reserved for insertion in full.

No. 6, August 6, 1877.

Experimental Researches with the Gases Produced by the Explosion of Dynamite on various Characteristics of Meteorites (continuation).—M. Daubrée.—The compression of the air which the meteorite drives before it produces not merely the heat, the incandescence, and the luminous train observed in such bodies. This compression contributes principally to the rupture of the mass, however tenacious, to the superficial tarnish of each fragment, and to the partial pulverisation of the substance.

Reply to some of the Objections advanced by M. Cosson against the Project of the Formation of a Saharian Sea.—M. Rouddaire.—An account of the beds of certain ancient rivers in the Sahara.

Comparative Influence of Leafy Trees and of Conifers upon the Rainfall and the Hygrometric Condition of the Air.—M. Fautrat.—The author shows that conifers, such as the various pines and firs, have a much greater influence than trees with true leaves. Hence he recommends the formation of pine-woods in Algeria.

On the Catechins.—Arm. Gautier.—A number of substances, having among themselves differences and analogies of the same order as the tannins which accompany them, have hitherto been confounded under the name of catechin. He distinguishes catechin from the yellow catechu of Bengal, $C_{21}H_{18}O_8$; catechin from a brown catechu of Pegu, agreeing in formula with the foregoing, but fusible at a temperature lower by 50°, and catechin from mahogany, $C_{42}H_{34}O_{16}$.

Experiments Proving that Chloroform has no Action either upon the Septicity or the Vibriones in Putrid Blood.—M. V. Feltz.—Chloroform mixed with putrid septic blood in the form of vapour, or added directly to this liquid, has no appreciable effect either on its vibriones nor on its septicity.

Biedermann's Central-Blatt fur Agrikultur Chemie,
Heft 4, April, 1877.

Carbonic Acid in "Ground Air."—Dr. Port.—Determinations of carbonic acid in the ground-air were made at Munich at depths of 1·5 to 3·0 metres. It appears that the greatest amount of carbonic acid was generally observed in the autumn. In most of the stations the proportion of carbonic acid was greater in 1873 than in 1874.

In some stations there was more carbonic acid found at the depth of 1·5 than at that of 3 metres, but in most instances the proportion was reversed. The proportion of carbonic acid in the ground-air gives a useful measure of the degree of pollution of the soil.

Condensation of Water in Arable Soils.—Prof. Adolph Mayer.—The author concludes that the condensing power of arable soils is of no importance for the nutrition of plants. On the contrary, the greater this condensing power is the less water does a soil place at the disposal of crops.

A Manurial Experiment with Beet-root.—M. Heidecke.—Not suitable for abstraction.

Researches on the Consumption of Oxygen and the Excretion of Carbonic Acid in Man.—Dr. Speck.—The author has examined the changes produced in the respiratory process by the use of fatty food, of coffee, quinine, alcohol, and water, and by the inspiration of air respectively rich in carbonic acid, poor in oxygen, and rich in oxygen. His chief conclusions are—(1) With an increased proportion of hydrogen in diet the amount of the air inspired and expired decreases. Nutriments, such as sugar, which contain little hydrogen in comparison with their oxygen, involve more exertion of the respiratory organs than such as are rich in hydrogen, like the fats. (2) The more carbon predominates in the food in proportion to hydrogen the more air is exhaled in proportion to that inhaled. (3) The more carbon increases in the diet in proportion to hydrogen, the more carbonic acid is evolved and the more oxygen taken up; the richer the diet in hydrogen the less oxygen is required. An atmosphere containing 5 or 6 per cent of carbonic acid could be breathed for some minutes without oppression. At 11·51 per cent great exertion was needful to breathe for one minute. At 7·2 per cent all the carbonic acid produced in the body is retained in the blood, and at 11·2 per cent a great part of that also which is inhaled.

The Origin and the Deposition of Glycogen in the Animal Organism.—Dr. S. Wolffberg and Dr. von Mering.

Locality of the Deposition of Fat in Animals under Different Diets.—Dr. G. Foster.—Not adapted for abstraction.

Decrease of Lime in the Body, and especially in the Bones, with Deficient Ingestion of Lime.—Dr. J. Foster.—If in a diet, ample as regards the constituents of the albuminoids, lime is insufficient, the muscles and also the skeleton show a deficiency in this earth.

Influence of Frost upon Cabbages.—Dr. Pagel and Prof. Märcker.—The action of frost occasions the formation of a considerable amount of sugar.

Evolution of Oxygen from Parts of Plants in the Absence of Carbonic Acid.—Prof. A. Mayer and Dr. H. de Fries.—A controversial paper of little importance.

Behaviour of the Saccharine Juice of Cells with Alcohol and Glycerin, and the Distribution of Sugar.—Prof. G. Kraus.—Not adapted for abstraction.

Detection of Certain Organic Compounds in Vegetable Tissues.—Dr. Ottomar Herrmann.—For the microchemical detection of datiscin the author recommends the application of lime- or baryta-water, which gives an intense yellow colour to the cells containing the glucoside. On the addition of acetic acid or dilute hydrochloric acid this colour at once disappears. In order to detect berberin we may use nitric acid. On merely examining plants containing this alkaloid we find in certain parts cells filled with a gold-yellow liquid or intense yellow membranes. On the addition of alcohol and very dilute nitric acid this colour disappears in a short time, and numerous gold-coloured crystals are formed, which chiefly occupy the interior of the cells in stellar groups. Sulphide of ammonium occasions a brown colouration. Colchicin takes an intense yellow colouration in contact with alkalies. To detect phloridzin we may utilise its deep brown-red solution in ferric chloride, and its brown-yellow precipitate with ferrous sulphate. The presence of a small quantity of tannic acid renders the colour deeper, but does not effectually mask the reaction. Larger quantities of tannin interfere. Curcumin is dissolved by mineral acids with a carmine-red colour, but not without decomposition. Its solutions give red-brown precipitates with the salts of lime and barium, and firey-red precipitates with the salts of lead. Nucin may be recognised by the purple-red colour which it assumes with alkalies, preferably with the fumes of ammonia. The colour is not permanent, and soon passes into various shades of brown. The author detects rutin by the intense yellow solutions which it forms with carbonated and caustic alkalies, lime- and baryta-water, and which on exposure to the air take up oxygen and turn brown. Plumbagin dissolves in alkalies with a red colour, which passes into yellow on the addition of an acid. Chrysophanic acid is recognised by the splendid purple-red colour with which it dissolves in aqueous alkalies. Frangulin takes a carmine-red with dilute potassa.

New Method for the Quantitative Determination of Crude Fibre.—Dr. Hugo Müller.—Already noticed.

Selection of Seed for Beets.—Dr. Jos. Hanamann.

Kinds of Potatoes Most Suitable for Cultivation on the Large Scale.—Eugène Marie.

Practical Studies on the Cultivation of Flax.—Gaetan Cantoni.—These papers refer more to practical husbandry than to the chemistry or physiology of plant-life.

Frozen Beets.—E. Barbet.—The author finds that frost converts sucrose into glucose.

Application of Tribasic Phosphoric Acid for Purifying Saccharine Juices.—A. Galwalowski.—The application of phosphoric acid seems to promote the removal of albuminoid matters.

Substitute for "Separate Saturation."—M. Maumené.—Technical details of the process of manufacturing beet-root sugar.

Gelatinous Deposits from Beet-root Juices.—Feltz, Jubert, and Kohlrausch.—An abstract of the views of the chemists mentioned.

Specific Rotation of Glucose.—Prof. Tollens.—From the *Berichte der Deutschen Chemischen zu Berlin.*

Conversion of Cane-Sugar into Reductive Sugar during Refining.—Aimé Girard.—From the *Comptes Rendus*, 1876, vol. 83, p. 196.

Researches in Brewing.—C. Lintner and Krandauer.—Incapable of abstraction, consisting chiefly of tables.

Transformation-products of Starch.—Cornelius O'Sullivan.—See Chemical News, vol. xxxiii., p. 218.

Analysis of Alsatian Wines.—Dr. Curt Weigelt.—A notice of certain Alsatian wines not known in commerce.

How to Avoid the Blackening of Wines.—Dr. P. Wagner.—The author recommends that no article of iron, such as nails, screws, &c., should be allowed to come in contact with the wine.

Dr. H. Soxhlet's Process for Making Butter.—E. Egan.—The author finds that this process, which consists substantially in freezing the cream before churning, produces butter in less time than the ordinary process. There is, however, a loss in quantity.

Archives Néerlandaises des Sciences Exactes et Naturelles, Tome x, 4me livraison.

Certain Substances derived from Uric Acid, or having relation with it.—E. Mulder.—The compounds described in this long and important paper are hydantoin, triglycolamide-triuramide, silver-cyanamide, carbo-di-imide, silver-urea, hydrous parabanic acid, dialurate of

urea, alluranic acid, with an account of its transformation into alloxanic acid, mycomelic acid, uranoxanic acid, and oxonic acid. The pre-existence of alloxane in the animal organism is also discussed.

Reaction of Sulphite of Ammonia upon Nitrobenzol.—J. A. Roorda Smit.—After reviewing the previous experiments of Piria, Laurent, Hillenkamp, and Carius, the author describes the compound which he obtained, the composition of which agreed with the formula—

$$C_6H_5.NH.SO_3NH_4.$$

Preparation of Acetate of Ammonia and of Acetamide.—J. Roorda Smit.—The author introduces glacial acetic acid into a spacious flask, and neutralises with carbonate of ammonia. In preparing acetamide he collects all the products which distil over below 200°, and neutralises with carbonate of ammonia.

Tome xi., 1ere Livraison.

Composition and Constitution of Plumieric Acid.—A. C. Oudemans, jun.—The author reduces the three plumieric acids of M. Altheer (α, β, and γ) to one, $C_{10}H_{10}O_5$. By submitting this to the action of sodium-amalgam he obtains dihydro-plumieric acid, $C_{10}H_{12}O_5$.

On the Liquid Xylenol obtained by means of Metaxylol (Isoxylol).—S. Lako.—The author's xylenol is identical with that of Wurtz.

Tome xi., 2me Livraison.

This issue contains no chemical matter.

Journal d'Hygiène,
Nos. 47, 48, 49, 50, 1877.

These issues contain no original chemical or physical matter.

MISCELLANEOUS.

University of London.—The following is a list of candidates who have passed the First B.Sc Examination:—*First Division.* Alfred Hodgetts Atkins, private study; Herbert Irving Bell, private study; Charles Frederick Cross, King's and Owens Colleges; Samuel Dixon, Owens College and private study; Henry Edmonds, private study; Lewis Humfrey Edmunds, University College; Walter Fowler, Caius College, Cambridge; Ernest Compton Gill, private study; Wintour Frederick Gwinnell, Royal School of Mines; Edward Harlock, Owens College; Hugh Erat Harrison, Univerity College; William Havelock Hill, University College; William Heaton Horrocks, Owens College; Moses John Jackson, University College; Alfred John King, Owens College; Frederick Herbert Lane, Epsom College; Joseph Larmor, St. John's College, Cambridge; Hyde Marriott, Owens College; Sidney Harris Cox Martin, University College; Samuel Sheppard Oakley Morris, private study; Thomas Jeffery Parker, Royal School of Mines; Herbert Pearce, University College; George Henry Spencer Pearson, private study; Richard Charles Rowe, M.A., Trinity College, Cambridge; Frederick Wallis Stoddart, University College, Bristol; Duncan Taylor, private study; William Henry Thomas, Royal College of Chemistry; Daniel Walker, Owens College and private study; Malcolm Webb, Owens College. *Second Division.* Isaac Blore, The Leys, Cambridge; Pramatha Nath Bose, University College; Edwin Drew, private study; Sidney John Hickson, University College; Henry Robert Hind, private study; Isaac Patchett, private study; Arthur Lee Sparkes, private tuition; Peter Thom, University of Aberdeen.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

July, 1877.

The following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·001	0·007	0·120	0·052	17·00	7·390	0·430	0·94	1·200	11·0	2·8
West Middlesex	Slightly turbid	0·000	0·007	0·105	0·053	17·10	7·280	0·210	0·94	1·330	11·8	3·3
Southwark and Vauxhall	Slightly turbid	0·001	0·008	0·090	0·050	20·70	7·950	0·360	0·87	1·260	12·1	2·8
Chelsea	Slightly turbid	0·000	0·007	0·090	0·057	17·40	7·440	0·320	0·87	1·200	12·1	2·4
Lambeth	Slightly turbid	0·000	0·009	0·120	0·052	17·00	7·160	0·280	0·94	1·460	11·8	3·3
Other Companies.												
Kent	Clear	0·000	0·003	0·300	0·015	26·70	9·350	0·820	1·30	2·200	17·0	5·1
New River	Clear	0·000	0·006	0·120	0·019	16·40	7·670	0·430	0·94	0·860	12·1	3·3
East London	Clear	0·000	0·007	0·090	0·046	18·30	7·780	0·210	1·01	1·260	12·1	3·3

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

Note.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. Meymott Tidy.

OWENS COLLEGE, MANCHESTER.—The NEXT SESSION WILL COMMENCE—In the Arts, Science, and Law Department, on the 2nd October, in the Medical Department on the 1st of October; and in the Evening Classes on the 15th October.

Candidates for admission must not be under 14 years of age, and in the Arts and Science Department those under 16 will be required to pass a Preliminary Examination in English, Arithmetic, and Elementary Latin.

Prospectuses of the several Departments may be obtained from Mr. Cornish and other Booksellers in Manchester, and at the College.

J. HOLME NICHOLSON, Registrar.

St. Mary's Hospital Medical School, PADDINGTON, W.—ENTRANCE SCHOLARSHIPS.—Two Scholarships in Natural Science, tenable for three years, one of the value of £60 the first year, £50 the second, and £20 the third year; and one of the value of £60 the first year, £25 the second, and £15 the third; also, an Exhibition, of the value of £20, tenable for one year—will be open for competition on Tuesday, October 2nd, 1877, and following days.

The Subjects of Examination are Inorganic Chemistry, Natural Philosophy, Mechanical Philosophy, Botany, and Zoology.

For further particulars and conditions apply to the Dean,

A. B. SHEPHERD, M.D.

THE CHEMICAL NEWS.

Vol. XXXVI. No. 928.

ON A NEW UNIT OF LIGHT FOR PHOTOMETRY.*

By A. VERNON HARCOURT, F.R.S., &c.,
One of the Metropolitan Gas Referees.

If we compare the corresponding operations of photometry and calorimetry, we have for the latter an unexceptionable scientific unit in the quantity of heat that will raise the temperature of a weight of water from the point of freezing, or of maximum density, through one degree. We have also a serviceable practical unit, for the comparison of various fuels, in the quantity of heat that will evaporate a pound of water. But for photometry there is no accepted scientific unit, nor even any sufficiently good practical unit for comparing different modes of illumination, or fixing the bargain made between gas companies and the public.

The unit which is actually employed for expressing and estimating the illuminating power of coal-gas is defined by Act of Parliament to be "a sperm candle of six to the pound, consuming 120 grs. of sperm per hour." One advantage the adoption of a candle as a unit has. It is generally intelligible. Every one has an impression of the amount of light which a candle gives; and the statement that a particular lamp gives the light of 10 candles conveys a tolerably good notion of the illuminating value of the lamp. This advantage, however, is by no means bound up with the use of candles in the operation of photometry. The name of candle might well be retained for a unit of light similar to the light of one candle, as "foot" and "grain" are employed for exact measures of length and weight, although the actual value of the unit were defined without reference to any particular kind of candle.

All who have used candles for photometry are familiar with the fluctuations and uncertainty to which their mode of burning and their varying character lead. It is only by a free use of averages that an approximately trustworthy result can be attained. Some well-devised experiments were made seven or eight years ago by Messrs. Kirkham and Sugg, with an apparatus called by them a cross-photometer, in which a single gas-flame was the central point of four candle photometers arranged crosswise, so that observations of its illuminating power might be made simultaneously by four observers. The differences in the results, after applying the usual proportional correction, where more or less sperm was consumed than the standard quantity, amounted frequently to two or three candles in the estimated value of a gas-flame of an average value of 14 candles. These experimental observations illustrate in a striking manner the uncertainty which attends the existing system of photometry; but the divergency includes the effect of other causes besides the difference between different pairs of candles, such as instrumental errors and the personal equation of the observers.

Where all precautions are taken, such as lighting the two candles, which are used simultaneously, at opposite ends, so that, their form being slightly conical, one may burn down towards the thicker, and the other towards the thinner end; when the candles are lit for some time before they are used; and when several successive observations are made, each with a different pair of candles, I find that the variations in the estimation of the same sample of coal-gas rarely exceed about half a candle, or 3 per cent. Occasionally, however, greater differences occur, and the average results of single sets of observations frequently vary by more than one candle, in the estimated illuminating power, even when the same pair of candles is used.

The source of these variations lies partly in external conditions; partly in the composition, and partly in the construction of the wick, of the candles. Atmospheric pressure and temperature affect the amount of light which a candle gives. Dr. Frankland has shown that a diminution of pressure promotes perfect combustion, corresponding to an increased supply of air, and *vice versâ*; so that at pressures less than the ordinary atmospheric pressure a smoky flame becomes clear, while under an increased pressure alcohol burns with a luminous flame. Thus the effect of changes of pressure may be compensated or may be exaggerated in the photometric estimation of coal-gas by the effect produced simultaneously, under different conditions or states of burning, upon the candle and the gas. When a candle-flame is long and smoking at the top, a slight decrease in atmospheric pressure would, no doubt, add to its illuminating power; when the combustion of the vapourised grease is perfect, diminished pressure would diminish the light. It has been pointed out by Dr. Heisch that with an Argand burner two different qualities of gas, burning at the same rate, may give the same amount of light—a poorer gas which the burner supplies with the quantity of air suitable for the full development of its illuminating power, and a richer gas which is burnt at a disadvantage, the supply of air being insufficient for its needs. In the first case, a small decrease in the atmospheric pressure would diminish, in the second it would increase, the quantity of light.

Differences in the temperature of the air affect the flame of a candle, by altering the distance between the bottom of the flame and the upper surface of the grease, or by keeping the cup of the candle more constantly filled with melted grease. In hotter weather a candle of a material with a comparatively high melting-point, such as spermaceti, which melts at a temperature varying from 109° F. to 112° F., according as it is prepared in winter or in summer, gives rather more light than in colder weather. The value of the same sample of gas tested with the same pair of candles appeared to be 18·2 candles at the temperature of the room, but only 16·9 candles when the temperature of the end of the photometer in which the candles were placed was raised artificially by about 20° F.

To give sperm candles a homogeneous appearance, the spermaceti is mixed with a small quantity of wax, the proportion of which is slightly varied. I am not aware whether this has any appreciable effect upon the illuminating power.

The sperm candles which are used for testing gas differ from those supplied to the public. They consume sperm less rapidly, and give less light.

The regulation of the rate of consumption is effected by varying the number of threads in the strands which form the wick. One of the principal makers of the candles used for gas-testing is now experimenting upon the effect of altering the strain upon the wick when it is fixed in the mould. A change in this respect may probably alter the curvature of the wick within the flame, and thus, perhaps, improve the light given by the candle.

A few years ago the nominal quality of the coal-gas supplied to the Metropolis was changed to the extent of nearly two candles by the adoption of a greatly improved burner in the photometer. It seems possible that if similar care and ingenuity are bestowed in perfecting sperm candles, within the parliamentary definition, which leaves not only the wick but also the diameter of the candle to the discretion of the makers, an improvement of 10 to 12 per cent may be effected, which would make the requirement of a higher illuminating power a reality.

Clearly, however, what is to be desired is, neither that the gas companies should gain an advantage by an im-

* A paper read before the Physical and Chemical Sections of the British Association at Plymouth.

provement in the test burner, nor that the representatives of the gas consumers should gain an advantage by the introduction of an improved standard candle, but that the system of photometry should be fixed upon such a basis that a contest of this kind would become impossible. A step in this direction was taken last year by the definition of the burner to be employed in testing. One of the Argand burners used in one of the official testing-places—of which there are now twelve in different parts of London, at each of which three testings are made daily of the illuminating power of the gas supplied—was measured and figured; and verified copies of this burner, which is to be exactly imitated for the future, were deposited with the Warden of the Standards, and with the Companies, and with the City and Metropolitan Board. But what is still needed is that equal definiteness should be secured for the unit of light or standard measure, which is employed to determine the amount of light which is yielded by a given sample of gas when burning as the rate of 5 cubic feet an hour at the standard burner.

Time will not permit me to do more than mention the methods which have been tried or have been suggested for this purpose. In Paris, the light with which the gas-flame is compared is a lamp consuming colza oil at the rate of 42 grms. an hour. Mr. Keates has proposed the adoption in this country of a similar lamp burning sperm oil. The light of the lamp is said to be more constant than that of candles, and the operator has the advantage of being able himself to adjust the rate of consumption. But the main difficulty in the way of definition and constancy in the case of candles—namely, the variable structure and varying condition of the wick—reappears in the case of lamps, though probably the variations are less in amount, owing to the power which exists of adjusting the wick and the greater simplicity of its form during combustion.

An ingenious kind of lamp was made some years ago by Mr. Crookes, in which the two *desiderata* of known composition of fuel and definition of the wick were secured by using for the fuel a mixture, in definite proportions, of benzene and alcohol, and for the wick a bundle of platinum wires of a particular size. Unfortunately, the light given by this lamp is only a fraction of the light of a candle, and thus it cannot be used for comparison with so bright a flame as that of gas burning at any ordinary gas-burner.

Other modes of photometry which have been tried or proposed I must, on this occasion, pass by, with the remark that since the value of an illuminant depends solely upon such parts of the total force radiating from a flame as affect the human eye, no test of illuminating power can be satisfactory which does not depend upon vision; at least, until it has been proved that some other effect of radiation, such as the impulse given to the radiometer, or the increase of the electric conductivity of selenium, is for all flames in direct proportion to the effect upon the optic nerve—a relation which seems very improbable, and which cannot be established until some exact mode of measuring the visual effect has first been found.

Three conditions need to be fulfilled for the production of a standard flame. First, the combustible must be of known and definite composition. Secondly, the conditions of burning must be of a simple and definable character. Thirdly, the nature of the combustible and of the conditions of burning must be such that atmospheric changes may produce a minimum of effect upon the light. A fourth condition might be added as highly desirable—namely, that the operator should be able to verify for himself the composition of the combustible he employs. No chemist, at least, would willingly spend time upon a quantitative operation for the accuracy and significance of which he was dependent upon the care exercised by the workmen of the best maker of candles or refiner of oil.

For reasons of another kind, it is desirable that a new unit of light should be made to correspond to the average value of the existing unit, the light given by a sperm candle consuming 120 grs. of sperm per hour. No change in the nomenclature of photometry would thus be required; the unit of light might still be called a candle, and gas which is described as 14-candle gas or 16-candle gas would retain its appellation, yielding, when burnt under standard conditions, the light of 14 or 16 of the new units.

After trying many different plans, an account of which would carry me far beyond the reasonable limits of this communication, I venture to think I have devised a method which satisfies fairly the conditions I have named. For the standard combustible I employ a mixture of air with that portion of American petroleum which, after repeated rectifications, distils at a temperature not exceeding 50° C. This liquid consists almost entirely of pentane, the fifth member of the series of paraffins. I have made three or four analyses of the liquid, which, though they scarcely distinguish between pentane and the adjoining hydrocarbons of the same series—the proportion of carbon to hydrogen being in pentane

Carbon ..	83·3	and in hexane	Carbon ..	83·7
Hydrogen ..	16·7		Hydrogen ..	16·3

—would reveal the presence of small quantities of hydrocarbons richer in carbon. I have also determined the vapour-density of the liquid. The density of gaseous pentane, compared with hydrogen, is 36; that of hexane 43. I find the vapour-density of the liquid, distilled twice below 50°, to be 37. The lighter portions of purified American petroleum have been carefully examined by Ronalds, Cahours, Warren, Schorlemmer, and other chemists, and have been found to consist of the following hydrocarbons:—Tetrane boiling between 0° and 4°, and having a specific gravity at 0° of 0·6; two isomeric pentanes, one boiling at 30°, the other at 37°, and having at 17° a specific gravity 0·626 (Schorlemmer), 0·628 (Cahours), the proportion of which appears to vary, since the hydrocarbon separated by Cahours boiled at 30°, while Schorlemmer states that the pentane in the sample examined by him consisted almost wholly of the variety boiling between 37° and 39°; hexane, which boils at 68° C., and has a specific gravity at 16° C. of 0·669. The liquid I use has a specific gravity which has only varied in different samples between 0·6298 and 0·63, except in one case, in which, probably owing to the temperature of distillation having been allowed to rise too high, it was 0·631. A sample distilled twice at 40° had the specific gravity 0·6276. It would not be difficult, by rectifying at 40°, to obtain almost absolutely pure pentane. But I do not think it necessary to limit the distillation to this temperature, because the yield at 50° is rather larger, and it seems hardly possible that the admixture of a small and nearly constant proportion of a substance so little different as hexane can affect the quality of the liquid as a combustible. Also I find, having distilled ten or twelve samples of the liquid, using about three litres each time, that I get a constant specific gravity.

To prepare the gas, I draw into the gasholder the required volume of air, chosen according to the capacity of the holder, and corrected for pressure, temperature, and tension of aqueous vapour. The volume may be measured either by means of a meter, or by a scale upon the gasholder. Then the corresponding proportion of pentane is poured into the gasholder from a measuring-flask, connected by means of glass and caoutchouc tubing with a tap in the upper plate. If the liquid pentane comes in contact with the plug of the tap, it acts on the grease which is used to lubricate the plug, and is liable thus to cause leakage. Contact is easily prevented by placing in the mouth of the tap a piece of caoutchouc holding a glass tube, which can slide, air-tight, up or down. The upper end of this glass tube is connected with the flask charged with pentane; the tap is opened, and the glass tube pushed down through the opening. When the contents of the flask have been poured through, and a minute or two allowed for drainage, the glass tube is drawn up until the

tap can be closed, and then the flask and connecting-tubes are removed. The proportion which I propose to maintain between the air and the pentane is 600 volumes of air to 1 volume of pentane, measuring the liquid at or near 60° F.; or, measuring both as gases, 20 of air to 7 of pentane, the vapour-density of pentane being such that it occupies as gas, under the normal conditions of 60° F. and 30 inches barometric pressure less the tension of aqueous vapour at 60°, 210 times the volume which it occupies as a liquid.

When the pentane is poured upon the water in the gas-holder with thrice its vapour-volume of air above, it volatilises rapidly and completely. A few minutes are sufficient for the volatilisation of the liquid, and a few hours suffice for perfect diffusion. It is clearly essential to the uniformity of the air-gas thus made that the liquid should be free from any admixture with non-volatile hydrocarbons, which would accumulate on the surface of the water, and dissolve or give up portions of the gaseous hydrocarbons, but the fulfilment of this condition is ensured by the repeated rectifications which are necessary to separate pentane from the hydrocarbons of higher boiling-point. It is also essential that this vapour or gas should be so slightly soluble in water that the proportion in the air-gas standing over the large volume of water in the tank of the gas-holder may not be appreciably affected by changes in the temperature of the water. Fortunately the gaseous paraffins are most sparingly soluble in water. I have enclosed the vapour of pentane at the tension of 261 millimetres over boiled-out water in an eudiometer for twenty-four hours, and 100 volumes of water dissolved only 0·92 volume of the gas. No doubt the first sample of gas made in the gas-holder filled with fresh water would suffer—and I find that it does suffer—some diminution in the proportion of pentane; but the error, if standard gas is kept in store for photometry, fresh portions being made from time to time over the same water, would only be such as could arise from the difference between the solubility of gaseous pentane, under a pressure of a quarter of an atmosphere, at one temperature and at another; and this error, though real, is likely to be infinitesimal. Many, and, as far as I know, all other substances, which otherwise might be used as the luminous ingredients of a standard gas, such as olefiant gas, or ether, or benzene, are excluded by the necessity of storing and measuring gas over water, and the comparative solubility of these substances in water.

The tension of the vapour of pentane at 17·4° C. is 417 m.m. Mixed with 1½ volume of air, it forms a perfect gas at a temperature of 16·8° C., and under pressures rising at least to 470 m.m. A portion of standard gas transferred from the gasholder to an eudiometer, and measured at various temperatures and pressures, gave the following results:—

Conditions.		Corrected
Temperature.	Pressure	Volume.
21·1° C.	737·4 m.m.	35·7 c.c.
21·3	933 9	35·6
15·0	764·8	35·4
10·0	761·8	35·4
4·0	756·4	35·5
4·0	910·0	34·3

Thus the gas is a perfect gas, suffering no condensation or abnormal contraction until it is exposed to conditions which could never occur in practice—a temperature of 4° C., and at the same time, a pressure of 1⅛ atmosphere.

A gas of constant composition having been thus prepared, the next problem is to devise a burner of so simple a construction that, with reasonable care on the part of the maker, there is no likelihood that out of a number of burners made on the same pattern there should be any difference between one and another capable of affecting the amount of illuminating power developed from the same sample of gas. For this purpose there must be no small measurements. I believe brass can be worked so that the error in such a matter as the diameter of a hole should not exceed 1-1000th of an inch. But where gas is burnt from a small nozzle, even this error may be material. The diameter of the holes in the standard Argand burner is 0·045 inch. A difference of 1-1000th of an inch in the diameter makes here a difference of 5 per cent in the area of the opening. When, as in the burner proposed to be used with the standard gas, the opening has a diameter of a quarter of an inch, its area would be affected by less than 1 per cent by a similar error. The other measurements involved in making this burner are larger, and are less important. The length of the brass tube which the gas enters near its base is 4 inches, its diameter is 1 inch, and the thickness of the disk which forms the mouthpiece is half an inch.

Another condition which the burner needs to fulfil, as far as possible, is that of giving a steady flame. It is not easy to produce a steady flame where gas does not issue under pressure, but flows out at a slow rate through a large hole. Under these conditions a long flame is always unsteady; but by employing a rich gas it is possible to get a cone of flame short enough to be almost as steady as the flame of a candle, and giving the same amount of light. When the gas has burned for a short time the whole length of the brass tube becomes moderately heated, and this contributes to steady the flame; for the gas burns in the axis of a cylinder of ascending air, which, having a definite set, is less swayed by lateral currents. I find that with this burner, either in the box-photometer or in an open photometer, in a room moderately free from draughts, no difficulty occurs through unsteadiness of flame.

I have here a single burner consuming standard gas at the rate of half a cubic foot an hour, and producing a flame whose height from the surface of the burner to the luminous tip, which in still air is almost as fixed and definite as the ivory point marking the level of the mercury in the reservoir of a barometer, is 2 inches and 5-16ths. The height to which the tip of the flame should reach is marked by a piece of platinum wire stretched across. Not only is the height of the flame serviceable as a check upon the preparation of the gas, since only gas which has been made with the due proportion of pentane will give a 2 and 5-16ths inch flame when burning at the rate of half a cubic foot an hour, but the regulation of the height of the flame is more important for the production of a fixed amount of light than the regulation of the rate of consumption.

I have made the experiments, in which I have varied the proportion of pentane to air to the extent of 10 per cent. each way. Such samples of gas give a great excess or defect of light when burnt at the normal rate of half a cubic foot an hour, but very nearly the right amount of light when the rate of consumption is neglected, and the height of the flame is adjusted at 2 and 5-16ths of an inch. I have tried also taking the usual proportion of air to pentane, but using, first, a liquid of rather higher boiling-point—that which distilled between 50° and 55°; and, secondly, the purer sample of pentane, obtained by rectifying twice at 40°. The result in the latter case hardly differed from those obtained with the pentane rectified at 50°; the former mixture gave, at first, a poorer gas, some of the hydrocarbon not having volatilised, and, after the addition of some of the normal mixture of air and pentane, a richer gas. In all cases the light was not far from the standard if the flame was set at the usual height, while the rate of consumption varied considerably.

These experiments show that if, instead of being intentionally varied, the mode of distillation and the proportion of air are kept carefully uniform, the light given by a flame of the standard length will be constant; also that, if the sample of gas has been prepared wrongly, the operator cannot fail to discover the fact by observing that the normal rate of burning does not give the normal height of flame. Any leakage between the meter and the burner would also announce itself in the same way.

What effect the actual barometric variations produce on

the standard flame I have not yet determined, nor is it known in the case of an ordinary gas-flame. It is assumed that a given volume of coal-gas, measured under standard conditions, will yield the same relative amount of light as compared with candles, under any such variations of atmospheric pressure as actually occur. This, as has been pointed out, is an improbable supposition. In comparing together the gas-light and the standard light, it is more likely, since both are gas-flames, that they would be similarly affected by atmospheric variations. This is certainly true of the volume of the two samples of gas; and thus, provided the rates of consumption, as registered by the meters, are 5 cubic feet an hour and 1 cubic foot respectively, no correction need be applied for these variations.

Even if the effect produced upon the light of the standard flame by such atmospheric variations as actually occur should prove to be slight, a definition of the unit must necessarily include a statement as to temperature and pressure. The unit which I propose, and which has been adjusted to correspond to the light of "a sperm candle consuming 120 grains of sperm per hour," is: "The light given by a mixture of 7 volumes of pentane gas with 20 volumes of air, burning from a $\frac{1}{2}$-inch orifice at the rate of half a cubic foot per hour, under the standard conditions of 60° F. and 30 inches pressure." For gas photometry it is convenient to use two such units in order to increase the distance between the disk and the standard light.

The question of the advantages or disadvantages of the unit here proposed is distinct from the question of the correspondence between this unit and the average illuminating value of a standard sperm candle. If, as the result of a more extended comparison than I have yet made, the two are found to be not in exact accordance, a slight alteration in the ratio of air to pentane must be made; but the mean result of 30 comparative experiments made with candles and with standard gas prepared in the manner described is:—

	Candles.	Standard Gas.
Illuminating power of gas with "London" Argand, burning 5 cubic feet per hour	18·0	18·14

The average results are almost identical, but the numbers obtained with candles vary much more one from another than the numbers obtained with standard gas. I have written up as an illustration the results of the last comparative experiment I have made.

	Candles.	Standard Gas.
Value of illuminating gas compared alternately with candles and with standard gas	18·0	17·6
	17·5	17·5
	18·1	17·6

The comparisons were made by setting the gas in an Evans photometer to burn at the rate of 5 cubic feet an hour, and placing alternately in the same position, at the opposite end of the instrument, a pair of sperm candles (applying in this case the usual corrections) and the double standard burner consuming standard gas at the rate of 1 cubic foot an hour.

PYRO-CHEMICAL ESSAYS.

By Lieut.-Col. W. A. ROSS, late R.A.

Finding that English chemists and mineralogists are for the most part still unacquainted with the processes developed in my work, "Pyrology, or Fire Chemistry," it is my intention, with the kind permission of the editor of the Chemical News, to publish in that journal the pyrological analyses of minerals from a cabinet purchased by myself in Freiberg. These analyses will be given alphabetically for facility of reference, and are intended to form a supplement to the book "Pyrology" when completed.

The operations are conducted entirely with Fletcher's[*] new hand blowpipe, of which, I believe, illustrated advertisements have already been given in the Chemical News. It consists of, beyond all comparison, the best blower I have ever seen, only one-fifth the price of Lingke's apparatus, and requiring scarcely any exertion of the right hand to keep up an intense blue "flame," but the wooden disk must be rested edgeways on the table, not flat as represented in the picture. By blowing *very* gently a broad blue flame is obtained, either from gas or a pyrological candle, over which may be boiled solutions, &c., in test-tubes or Berlin capsules, better than over a spirit-lamp or Bunsen burner, because when well heated the capsule may be held 3 inches *in front* of the blowpipe, whereby all spirting is avoided. The travelling pyrologist, therefore, need not now take a spirit-lamp or spirits with him at all.

I. *Adularia.*

As it happens, this first mineral on the list is one of the most troublesome to analyse in the whole cabinet, on account of the action of the potash which it contains upon the boric acid bead, whereby the formation of combined lime or other borate balls is prevented; but the English student will see by a reference to Prof. Cornwall's admirable American translation how very little Plattner and Richter have been able to determine in *Adularia* by the blowpipe, even with the assistance of hydrochloric acid.

(1.) *Appearance.*—Colourless, transparent, vitreous; crushes easily in (*a*) forceps;* hardness less than quartz.

(2.) The fine powder in a bead of boric acid; gave merely a transparent edgeless mass like melting ice, which was proof that an alkaline silicate (probably containing alumina) was there.

(3.) A speck of cobalt oxide added to (2) bead B.B. did not merely form a black ball, but diffused a pink colour, showing that more than 5 and under 20 per cent of alkali was present.

(4.) A fragment of the mineral strongly heated B.B., and held in platinum forceps in the *upper* part of the base of the blue gas "flame" or pyrocone, where the blast passes, afforded a continuous violet colour, showing that the alkali was potash.

Collection of Evidence.

We have now proof that the mineral is a silicate (for though not unlike transparent quartz it was not hard enough for that) containing free potash, otherwise the "flame" in (4) would have been orange. It was probably, therefore, aluminium silicate containing potash, which always gives an icy mass in boric acid (2), and we saw from (3) and (4) that there was from 5 to 20 per cent of potash in it. Some special treatment, therefore, became necessary to try to separate constituents, and to see if any others were there. With this view I tried the following methods:—

Method 1.—Boiled the fine powder, crushed between agates in water acidulated with boric acid, and treated the residue B.B. in a bead of boric acid.

Method 2.—Fused the fine powder B.B. in a bead composed of equal parts of boric and phosphoric acids; boiled the resulting bead as in (1), decanted the solution, and treated the residue B.B. in boric acid.

Method 3.—Crushed the mineral to a fine paste between agates with some drops of water and crystals of boric acid; boiled in fresh boric acid water, and treated residue B.B. in boric acid.

Method 4.—Crushed the mineral to a fine paste between agates with sodium carbonate and water; fused the paste B.B. on aluminium plate; crushed the resulting ball with (*a*) forceps, boiled the powder in boric acid water, and treated the residue B.B. in boric acid.

Method 5.—Crushed the mineral to a fine paste between agates with 3 drops of a strong solution of phosphoric

* These references apply to my work, "Pyrology, or Fire Chemistry," Spon: 1875. Any new manipulations will be detailed in foot-notes.

acid, washed it into a Berlin capsule with distilled water, and boiled for three minutes; evaporated the solution to dryness in a platinum capsule, and treated the residuum B.B. in boric acid.

As these five differing methods of treatment—which occupied some weeks—all failed to give a decided result, *i.e.*, the residue obtained gave only transparent matter, like melting ice, in a bead of boric acid before the blowpipe, or, in the words of Des Cloizeaux and other writers on silicates, *Adularia* is "inattackable par les acides," I made a sixth essay, which is detailed as follows:—

Method 6.—(1.) Fused about 50 m.grms. of fine powdered *Adularia* in a bead of phosphoric acid before the blowpipe; an undissolved transparent mass (SiO_2?), the bead becoming gelatinous and yellowish like horn by transmitted light. (This operation is founded on the previously-ascertained fact that alumina is thus rapidly dissolved, while silica remains insoluble.)

(2.) Boiled the bead (1.) in a Berlin capsule over a Fletcher pyrocone, extracted the siliceous mass, decanted the solution (which had a sweet sub-acid taste) into a test-tube, added a few drops of solution of sodium hydrate, and boiled gently over the pyrocone; a yellowish white, flocculent, slowly falling precipitate (of aluminium hydrate?)

This precipitate, dried on a red-hot platinum spatula, and treated in a bead of boric acid, afforded transparent matter, which seemed to rapidly dissolve B.B. in the bead, but on close lens examination showed minute rounded white fragments (alumina).

Collection of Evidence.

We thus find that *Adularia is* "attackable" by one acid at all events; that the specimen here examined contains no lime, a large proportion of silica, a considerable quantity of alumina, between 5 and 20 per cent potash, and by Method 2 (which there is not space here to detail) a brownish residue showing in a boric acid bead minute rusty-brown balls, which is the reaction of sesquioxide of iron.

Other minerals of the same class will, of course, occupy much less space than the above, and will be examined only by Methods 2 and 6.

London, August 29, 1877.

ON OPTICALLY INACTIVE SUGAR.

By W. E. HALSE and J. STEINER.

Some time ago we received for analysis a sample of liquor taken from the hold of a ship which had brought over a cargo of cane-sugar from the Colonies. This liquor represented the drainings of the sugar mixed with the bilge-waters. It had a dark brown colour, a salt and sweet taste, and had an odour like molasses. The analysis showed—

Organic matter	42·50
Water	51·75
Ash..	5·75

The ash consisted of the mineral matter of the sea-water and the soluble part of the ash of the cane-sugar.

The liquor was clarified with sub-acetate of lead, and the excess of the lead removed by sulphurous acid, and then tested in the general way. It showed no influence on the polarised ray, but reduced the copper solution to an amount equal to 27·70 per cent of glucose. The same result was also obtained when it was tested without being clarified. As to the nature of this sugar, two cases were possible: it either might be a mixture of levulose and dextrose, or levulose and saccharose in such a proportion that their opposite rotations compensated each other; or simply a sugar having no action whatever on polarised light.

In order, therefore, to identify this sugar, we submitted the liquor to the following tests:—To a part of it some yeast was added. Fermentation soon set in and progressed rapidly. Whilst in this state it was again tried in the polariscope, but no rotation was observed. Had it been a mixture of levulose and dextrose a levo-rotation would have made itself evident now, as dextrose ferments and disappears first in such a case.

Another part of the liquor was treated with dilute alkali, and heated with a view of destroying the levulose, and thus obtaining dextro-rotation had cane-sugar been present; but again no rotation was noticed. The sugar in this liquor is therefore not a mixture, but a special kind of a sugar which is optically inactive.

Chemists who have to deal with cane-sugar are often led to believe from the results of their analyses that the fruit-sugar present in it is without influence on polarised light, but it may be considered an exceptional case to meet with molasses containing only optically inactive sugar.

Laboratory, 21, Mincing Lane.

NOTICES OF BOOKS.

Medical Science in Relation to the Voice as a Musical Instrument. By LENNOX BROWNE, F.R.C.S. Edinburgh. (Read before the Musical Association of London, and reprinted from the *Transactions*.) London: Chappell and Co.

This pamphlet can scarcely be appreciated save by musicians, or by such as have studied acoustics and the physiology of the vocal organs from a musical point of view. The author remarks that he has had analyses made of every variety of patent voice lozenges, and finds that they all contain cayenne pepper or some analogous irritant. He blames singing-masters for prescribing to their pupils remedies for affections of the voice of which they know nothing, except that such have been serviceable to themselves or their friends under diseased conditions, probably totally different. The vocalist is warned not to be afraid of air, but reminded that he should avoid sudden changes of atmosphere and also dust. "He should never foster the idea that alcoholic stimulant of any kind is necessary to the exercise of his art any more than it is to that of the painter or the author."

The Retrospect of Medicine. Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. Vol. lxxxv., January to June, 1877. London: Simpkin, Marshall, and Co.

In a paper on the use of peroxide of hydrogen for preventing the spread of scarlet fever and smallpox we find the interesting statement that pus-cells exalt the chemical activity of this compound, and give it "the oxidising powers of ozone." Dr. S. Wilks, in an article on "Alcoholism," maintains that alcohol, strictly speaking, is not a stimulant, but an anæsthetic. He shows that though not a necessary of life—an indispensable article of food—it is at the same time a useful medicine, and is called for in a quick pulse and high temperature. In cases of wasting, especially in children, it is often more effectual than cod-liver oil. The author drily remarks—"You may have observed that whiskey has taken the place of brandy in the medical dietary. I have failed to discover the reason, so I suppose it is a secret of the distillers." Dr. W. G. Smith reviews the various tests proposed for the detection of bile-pigment, and gives the preference to the acetic or phosphoric solution of peroxide of lead, and to peroxide of hydrogen. Tincture of iodine is exceedingly sensitive, giving like the two former reagents a brilliant

green colour in urine containing bile-pigment, but it has the disadvantage of being in itself coloured. The value and delicacy of the nitric acid test are less than what is commonly supposed.

For generating sulphurous acid as a disinfectant Mr. Keates proposes the combustion of bisulphide of carbon in a lamp so contrived as to prevent the volatilisation of the liquid.

This volume of the "Retrospect," like most of its predecessors, is rich in matter valuable to the medical practitioner, though the passages interesting to the chemist are necessarily few.

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*Programme of the Royal Rhenish-Westphalian Polytechnic School at Aachen for the Course 1877 to 1878.**

WE have repeatedly found occasion to admire the arrangements of this college and the thoroughness of its educational courses, especially as regards chemistry and its application to the arts. We have now merely to add that it maintains the high character it has already acquired.

The Chemist's Manual: a Practical Treatise on Chemistry, Qualitative and Quantitative Analysis, Stoichiometry, Blowpipe Analysis, Mineralogy, Assaying, Toxicology, &c. By HENRY A. MOTT, jun., Ph.D. New York: Van Nostrand.

THIS work, the author tells us, has sprung from a collection of notes and tables compiled originally for his own convenience. Gradually the resulting memoranda became too bulky for the pocket, and assumed the form of a manuscript book lying ready for reference upon the laboratory table. At the request of a number of scientific men it has appeared in its present shape as a substantial volume of some six hundred pages.

The contents, as appears from the very title, are of a somewhat promiscuous character. There is, in the first place, a section on qualitative analysis. Here we find the characteristic reactions of the metals (arranged in the ordinary analytical groups) stated with considerable minuteness, the rarer elements not being omitted. In equations used to exemplify reactions the author uses the $\Delta\delta$ to signify heat. Thus, in explaining the production of chromic oxide and oxygen gas from mercurous chromate, he gives the following formulæ:—

$$4Hg_2CrO_4 + \Delta\delta = 2Cr_2O_3 + 8Hg + 10O.$$

Such equations have the disadvantage that the symbol $\Delta\delta$ never reappears on the other side, and they might lead the reader to believe heat to be a material element. Upon this section follows a scheme for the qualitative examination of an unknown substance; a "complete table of analytical chemistry," by James Hayward: a scheme for qualitative analysis without the use of sulphuretted hydrogen or hydrosulphate of ammonia, drawn up by Zettnow, and destined we presume for the use of persons with eminently delicate olfactories; the Stas-Otto scheme for the recognition of the organic alkalies; Trapp's instructions for the same purpose; Wenzell's table of the tests for strychnia; the reactions of fatty oils, with acids and alkalies, taken from "Watts's Dictionary of Chemistry;" Glassner's scheme for the analysis of fatty oils; tables of the specific gravities, optical properties, and boiling-points of essential oils and hydrocarbons derived from such; Attfield's table of official tests for impurities in pharmacopœial preparations; Grothe's table of the reactions of metallic salts with the alkalies, &c., in presence of non-volatile organic matter, such as citric acid, sugar, &c.

Next follows a section on specific gravities, with hydrometric tables, one of which shows the degrees of Twaddle in comparison with direct specific gravity, but singularly only as far as 28°.

The mineralogical chapter consists of an account of the sources of those elementary bodies which, in a simple or combined state, are used in the arts. Amongst these we find strontium, whilst barium, whose practical applications are far more extensive, is omitted. The localities of the different minerals are very naturally stated with a preponderating reference to America. Towards the end of the chapter we find a geological section of the Oil Creek region, and an account of the distillation-products of crude petroleum.

Upon this follow a section devoted to stoichiometrical calculations and a table of solubilities.

The chapter on quantitative analysis consists of instructions for determining the constituents of a number of bodies, such as iron ores and slags, chrome-iron, pig-lead, nickel ore, copper ore, manganese, manures, &c., the substances selected being probably such as have principally come under the author's professional notice. Saccharimetry is explained in detail.

Next follows a section on assaying—a term, by the way, which we have never seen defined with accuracy as distinguished from quantitative analysis. Some writers seem to call every commercial analysis an assay; some restrict the term to operations where only one constituent of a compound is estimated; whilst others, like our author, seem to understand by an assay an analysis performed in the dry way.

A curious chapter entitled "Analysis of a Man" gives the total ultimate composition of a human body of the weight of 154 lbs., and of the principal vital fluids, secretions, &c.

Next follows an abstract of Mendeleeff's views on the classification of the elements, and a "chronological table of defunct elements;" or, in other words, a list of bodies supposed at one time or other to be elementary, but which were rejected on further scrutiny. Among these ex-elements, which number no fewer than 42, we meet with our old friends andronia and thelyke. It is curious that the name thallium was for a short time time claimed by one of these supposed simple bodies, discovered by Owen in 1852.

Upon this follow an assortment of tables, one of which shows the "formulæ of frequently occurring substances." Here we find copperas or green vitriol written simply as $FeSO_4$, the $7H_2O$ being omitted.

A short section on poisons and their antidotes includes such comparatively harmless substances as iron and phosphoric acid, but omits the compounds of chromium and of tin, the former of which are exceedingly formidable, and from their extensive applications in the arts very liable to occasion accidents. The homœopathic treatment is indicated in every case.

To pass a definite judgment upon a work like this is exceedingly difficult. Probably most chemists will find in it no small amount of matter which is not merely useful, but which is sometimes not easy to meet with when required. On the other hand, a large part of the contents will, we think, be regarded as superfluous by a majority of the profession. The author declares in his preface that "every scientific man should compile his own pocket-book, as he proceeds in study and practice to suit his particular business," and in so saying he admits that a compilation of this kind must be of very different value to different persons. Typographical errors are numerous, especially in the names of the authorities cited.

Thirteenth Annual Report of the Alumni Association of the Philadelphia College of Pharmacy. 1877.

THIS pamphlet contains an introductory lecture to the fifty-sixth session of the Philadelphia College of Pharmacy, by Prof. J. M. Maisch, in which particular weight is laid on the pharmaceutical products at the late Centennial Exhibition.

* Programm der Königlichen Rheinisch Westfälischen Polytechnischen Schule zu Aachen.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 7, Aug. 13, 1877.

Best Conditions for the Use of Galvanometers.—M. Th. du Moncel.—This paper is not suitable for abstraction.

Vapour of Chloral Hydrate.—M. L. Troost.—The author proves that chloral hydrate exists in the gaseous state, and that its equivalent corresponds to 8 volumes.

Certain Properties of Cadmium Sulphide.—M. Ditte.—Cadmium generally ranks among the metals whose sulphides are insoluble in alkaline sulphides; it may, nevertheless, happen that a liquid containing cadmium is not precipitated by the hydrosulphate of ammonia, but that the metal is found in the filtrate obtained by treating with this reagent the sulphides formed by the action of a current of hydrosulphuric acid. Sulphide of cadmium is in fact soluble in hydrosulphate of ammonia at common temperatures. If a few drops of this reagent are added to a dilute solution of cadmium we obtain at first the characteristic yellow precipitate, which dissolves, however, if the alkaline sulphide is added in excess. The same thing happens if cadmium sulphide is formed at first by the action of sulphuretted hydrogen and is then treated with hydrosulphate of ammonia; the liquid becomes clear and the precipitate disappears entirely. This solubility cannot be ascribed to the presence of a small excess of ammonia in the hydrosulphate, for this base, though it readily dissolves certain salts of cadmium, is without action upon the sulphide at common temperatures. The solubility of cadmium sulphide augments on raising the temperature of the ammoniacal salt, and at 60° it is about double what it is in the cold. Even if the cadmium sulphide, after precipitation with H_2S, is boiled, it is still soluble in the hydrosulphate. The solution made at 60° if left in a closed vessel deposits a part of the cadmium sulphide which it had taken up, and if the cooling is very slow it deposits small transparent crystals, which are anew soluble in hydrosulphate of ammonia. If a solution of hydrosulphate of ammonia saturated with cadmium sulphide is slowly evaporated over quicklime we obtain upon the sides of the receiver a white pulverulent deposit of ammonium sulphide, whilst a mixture of crystals of sulphur and of cadmium sulphide remains at the bottom of the vessel. The sulphur separates in small octahedra and in plates generally white, becoming yellow slowly on contact with the air, but rapidly on friction. The sulphide of cadmium is deposited in aggregations of very small crystals. The saturated solution of cadmium sulphide contains about 2 grms. per litre, a solubility slight but still much greater than that of copper in the hydrosulphate of ammonia, where yet it is customary to employ in preference the sulphides of potassium or sodium. If a solution contains but very little cadmium this metal may totally disappear under the influence of hydrosulphate of ammonia, without its reappearing in the precipitate which might be expected to contain it. Potassium and sodium sulphides do not dissolve it appreciably even at 50° or 60°, and it seems therefore to use these alkaline sulphides for the separation of cadmium, as in the case of copper. But when hydrosulphate of ammonia is employed to separate the sulphides which it dissolves from those which are insoluble, it is necessary to search for cadmium not merely in the residue but also in the filtrate.

Certain General Properties of Metallic Sulphides.—MM. Ph. de Clermont and H. Guiot.—An ammoniacal salt heated to 100° in a distillatory apparatus with water and a metallic sulphide yields ammonium sulphide, but when all the ammoniacal salt is decomposed and the disengagement of ammonia has ceased, there is still a production of sulphuretted hydrogen due to the decomposition of the metallic sulphide in presence of water. The authors' experiments, which prove the decomposition of the sulphides by water at 100° with formation of a metallic oxide and of sulphuretted hydrogen, contribute a new argument in support of the view that hydrogen is a metal. It displaces, in fact, in these reactions true metals, and forms a sulphur compound more stable at these temperatures, *i.e.*, sulphuretted hydrogen. Moist carbonic acid decomposes manganese sulphide at common temperatures, but in presence of boiling water the decomposition is very rapid. At common temperatures hydrogen does not decompose rose-coloured manganese sulphide. The green hydrated manganese sulphide is decomposed by carbonic acid, but less rapidly than the rose sulphide. Iron sulphide is likewise decomposed and more slowly than the above, contrary to the assertion of Wagner. Green anhydrous manganese sulphide suspended in water is decomposed still more slowly. In all these cases there is produced a metallic carbonate and sulphuretted hydrogen. The sulphides of silver, lead, and antimony resisted the action of carbonic acid.

Gazzetta Chimica Italiana, Anno vii., 1877, Fas. vi.

Note on Sordidin.—E. Paterno.—In his memoir on usnic acid the author announced the discovery of a new proximate principle found in *Zeora sordida*, to which he gave the name of sordidin. Having now obtained it in a state of purity he finds that it contains—

Carbon	53·06
Hydrogen	3·40

and that it may be represented by the formula $C_{13}H_{10}O_8$.

Nitro-Derivative of Para-oxybenzoic Aldehyd.—G. Mazzara.—The compound in question, mono-nitro-para-oxybenzoic aldehyd, is expressed by the formula—

$$C_6H_3\begin{cases}OH\\COH\\N_2\end{cases}$$

It has the characters of a strong acid, and readily decomposes carbonates. Its potassic salt,—

$$C_6H_3COHNO_2OK+H_2O,$$

crystallises from water in splendid gold-coloured tablets, and loses its crystalline water about 70°.

Quantitative Separation of Iron and Manganese in Ferro-manganic Minerals.—Dr. Angiolo Funaro.—Reserved for more extended insertion.

Chromic Acid as a Reagent for Malic Acid.—G. Papasogli and A. Poli.—If to 5 c.c. of water containing a few milligrms. of malic acid, free or combined, there are added a few drops of dilute sulphuric acid along with a crystal of bichromate of potash, and the liquid is then raised to a boil, it passes from a yellow to a green colour, emitting a distinct odour of the ripe fruit. As this reaction is not common to the citric and succinic acids, it seemed that it might be employed with good success for the detection of malic acid when mixed with the two others. The authors recommend the following modification of the process of Fresenius:—Having obtained the precipitate of the calcic salts of the acids in alcohol, the latter body must be completely driven away, when a small quantity of the precipitate is taken, treated with dilute sulphuric acid, the precipitate of sulphate of lime produced is filtered off, and to the filtrate a small crystal of bichromate of potash is added, and the liquid is several times raised to a boil. It is then needful to observe—(1) If the liquid still remains of a yellow colour, even after a prolonged ebullition, this indicates the presence of succinic acid alone. As a check test the remnant of the precipitate may be tested with ferric chloride. (2) If the liquid passes from a yellow to a

green without giving off the smell of ripe fruit, this indicates the presence of citric acid alone or accompanied with the succinic. (3) If the liquid turns green, and gives off the odour of ripe fruit on cooling—an odour which recalls that of medlars when fully mature—the presence of citric acid is indicated.

Observations on a Memoir by G. Musso.—Prof. Damiano Macaluso.—A mathematical paper, not suitable for abstraction.

Action of Light and Carbonic Acid upon Aqueous Solutions of Iodide of Potassium, and on Ozonoscopic Paper.—G. Pellagri.—Carbonic acid in quantity, especially in the form of a current, liberates hydriodic acid from potassium iodide. If a current of carbonic acid is passed over a mixture of iodide and iodate of potassium, iodine is liberated without the intervention of light. Direct light sets free iodine in ozonoscopic paper, and therefore also in a solution of iodide of potassium without the intervention of carbonic acid and of ozone.

New Reaction for Morphia.—G. Pellagri.—The solution of the suspected matter is evaporated at a gentle heat; the residue is treated with concentrated hydrochloric acid to which a small quantity of pure concentrated sulphuric acid has been added; and the mixture is evaporated in the oil-bath at from 100° to 120°. Whilst the hydrochloric acid disappears, a most beautiful purple colour begins to form on the edges of the capsule, which is not masked by the carbonisation of the organic matter; then a red colour extends down towards the centre of the capsule, and when all the hydrochloric acid has disappeared the remaining sulphuric acid appears of a red colour. At this moment the capsule is carefully taken out of the bath, a little hydrochloric acid is added, and the whole is neutralised with bicarbonate of soda. A violet colour is then produced, which does not alter in the air nor dissolve in ether. If a drop of iodiuretted hydriodic acid is now added the violet colour changes to a green, which dissolves in ether with a purple colour. Codeia gives the same reactions, but as morphia is insoluble in ether the two may be easily distinguished. Brucin treated in the same way, on neutralisation with bicarbonate of soda, gives a beautiful azure, which turns red with iodine.

Archives Néerlandaises des Sciences Exactes et Naturelles,
Tome x., 5me Livraison.

Relations between Physical Properties and Chemical Constitution.—J. A. Roorda Smit.—Of late increased attention has been given to the connection between the physical properties of bodies and their chemical composition. M. van 't Hoff, in a work entitled *Chemistry in Space* ("La Chimie dans l'Espace") has considered the constitution of bodies in a space of three dimensions, and has detected a remarkable relation between chemical constitution and the power of acting upon polarised light. M. Spring (*Ann. de la Soc. Géol. de Belgique*, t. ii.) has pointed out a connection between crystalline form and the valence of the atoms constituting chemical compounds. M. Smit hopes to be able to give an explanation of isomerism, allotropy, &c. He thinks that the properties of compounds, physical as well as chemical, depend not merely on chemical composition as admitted at present, but on true molecular magnitude and correlative constitution, hitherto unknown. He considers that the only explanation of the facts in question is to take another molecular magnitude than that hitherto adopted, admitting that the crystalline molecules are polymeres of the vapour molecules, and that a different degree of polymerisation is the cause of the phenomena of dimorphism and allotropy. The paper, which does not admit of complete abstraction, will repay a careful perusal.

Tome xi., 3me Livraison.

Description of the Compass of Intensity.—F. J. Stamkart.

Note on the Use of the Compass of Intensity to find the Deviation of the Magnetic Needle on Ship Board.—F. J. Stamkart.

Horizontal Intensity of Terrestrial Magnetism.—F. J. Stamkart.—These three papers are not adapted for abstraction.

Tome xi., 4me Livraison.

Artificial Digestion of Cellulose.—T. H. MacGillavry.—The mucous membrane of the vermicular appendage of the cœcum in rabbits yields a secretion, which in a mixture having an alkaline reaction transforms cellulose into a matter soluble in water. This matter if submitted to Brücke's test behaves like glucose, with which it will probably be identified on a closer examination.

Tome xi., 5me Livraison.

This issue contains no chemical or chemico-physical matter.

Tome xii., 1me Livraison.

Determination of Quinine in Cinchona Barks by Means of the Polaristrobometer.—A. C. Oudemans, Jr.—The author, in his memoir on the specific rotatory power of the principal cinchona alkaloids, expressed the opinion that the use of the polaristrobometer might become a useful adjunct in the quantitative analysis of mixtures of two or more of these alkaloids. He has now endeavoured to show by examples that the disturbing influences exerted by variations in the degree of concentration, or by the simultaneous presence of different alkaloids, are so slight that this method of determination gives results much more accurate than those obtained by purely chemical procedures. He finds that it is possible to determine by means of the polaristrobometer the amount of quinine in the mixed tartrates of quinine and cinchonidin as obtained by precipitation from the solutions of the barks. His result is a refutation of the unfavourable opinion which Hesse has too precipitately passed (*Ann. der Chemie u. Pharm.*, clxvi., p. 230) on the utility of such determinations.

On Cuprous Hydride.—W. K. J. Schoor.—On adding to dilute sulphuric acid and metallic zinc a solution of sulphate of copper this hydride is formed. After filtering and washing it appears as a brown powder, which evolves hydrogen on contact with pure water. If treated with hydrochloric acid pure hydrogen escapes and cuprous chloride dissolves, from which hydrated cuprous oxide may be precipitated. The composition of the hydride is Cu_2H_2.

Revue Universelle des Mines,
March and April, 1877.

This issue contains no original chemical matter.

Beiblatter zu den Annalen der Physik und Chemie,
No. 1, 1877, Band 1, stück 1.

On Saline Solutions and Combined Water.—F Guthrie.—An abstract of certain papers by Dr. Guthrie to be found in the *Phil. Mag.*, xlix., 1, 206, 266; 1, 49, 351, 446; 2, 211.

Transition State between Gases and Liquids. Inaugural dissertation (Leiden: Sijthoff, 1873).—J. D. van der Waals.—A mathematical paper, incapable of useful abstraction.

Preliminary Notice on Further Researches concerning the Physical Properties of Matter in the Liquid and Gaseous Condition at Different Temperatures.—T. Andrews.

Gaseous Condition of Matter.—T. Andrews.—The former of these papers is taken from the *Phil. Mag.*, i., p. 78, and the latter from the *Proc. Royal Soc.*, xxiv., 455, April 27, 1876.

Specific Heats of Saline Solutions.—J. C. Marignac (*Ann. der Chimie*, viii., 410).—An investigation of the question whether the specific heats of saline solutions can be calculated from the specific heats of their constituents, at least approximately, as is the case with specific gravities. If this is not the case can relations be traced to other properties of the salts, especially to their tendency to form definite crystalline hydrates? The author finds that the specific heat of saline solutions is generally less than the sum of the specific heats of their individual constituents. This rule is not, however, free from exceptions and does not hold good with most acetates.

Experiments on the Acoustic Properties of Metals, Woods, and Stones.—C. Decharme (*Inst.*, iv., 225, &c.)—The author comes to the conclusion that the results differ somewhat with different specimens.

Investigations on the Spectra of Non-metallic Bodies.—J. Angstrom and T. R. Thalén (*Acta Soc. Upsal.*, vol. ix., 2 plates).—A minute examination of the spectra of carbon and nitrogen. The authors make the following preliminary remarks:—"We are far from entertaining the view that with an increasing temperature or even an augmentation of the mass of the incandescent gases the number of the luminous bands cannot increase. As little do we deny that the brightness of certain bands may increase more rapidly than that of others. On the other hand the assertion of certain physicists that lines originally visible may totally disappear, thus totally altering the character of the spectrum, is theoretically improbable and contradictory to experience. We do not deny that an elementary body may under certain circumstances give different spectra. Thus the absorption spectrum of iodine is totally different from the system of bright lines which this same substance gives when exposed to a discharge of sparks. Any body capable of allotropic modifications shows also different spectra, provided always that this capability still exists in the gaseous condition and at the temperature in question. On the supposition that allotropism occurs in gases, every allotropic condition will have a certain absorption spectrum; but if only one of these conditions can bear the temperature of incandescence only one spectrum will be obtained at this temperature, the ordinary line spectrum.

A New Relation between Electricity and Light. Double Refraction in Dielectric Media.—J. Kerr.—From the *Phil. Mag.*, l., 337, 446.

Repetition of Experiments on a New Relation between Electricity and Light.—J. E. Gordon.—From the *Phil. Mag.*, ii., p. 203, 1876.

Residue of the Leyden Jar.—J. Hopkinson.—Taken from the *Phil. Mag.*, ii., p. 314.

New Electric Lamp Invented by M. Jabloschkoff.—M. Denayrouze.—*Comptes Rendus*, lxxxiii., p. 813, 1876.

MISCELLANEOUS.

University of London.—The following is a list of those who have passed the recent Examination for Honours in Chemistry and Experimental Physics:—First B.Sc. and Preliminary M.B. conjointly (*Chemistry*):—First Class. C. F. Cross, First B.Sc. (Exhibition), King's and Owens Colleges, and W. H. Thomas, First B.Sc. (disqualified by age for the Exhibition), Royal College of Chemistry, equal. Second Class. A. H. N. Lewers, Prel. Sci., University College; A. Barron, Prel. Sci., Owens College. Third Class. C. E. Cassal, Prel. Sci., University College; H. I. Bell, First B.Sc., private study; H. Marriot, First B.Sc. and Prel. Sci., Owens College, and H. Pearce, First B.Sc., University College, equal; F. W. Stoddart, First B.Sc. and Prel. Sci., University College, Bristol. (*Experimental Physics*):—First Class. J. Larmor, First B.Sc. (Arnott Exhibition and Medal), St. John's College, Cambridge; M. J. Jackson, First B.Sc. (Arnott Medal), University College. Second Class. H. E. Harrison, First B.Sc., University College, and H. Pearce, First B.Sc., University College, equal. Third Class. E. L. Adeney, Prel. Sci., Guy's Hospital; O. J. Currie, Prel. Sci., Guy's Hospital.

Russian Scientific News.—Prof. N. Sokoloff has examined some methods for the extraction of hydrocyanic acid from its solutions by distillation. Solutions of this acid being distilled, the acid separates very slowly: in the first portions of the distillate the acid may be discovered by its reaction on a mixture of $NaHO$, $FeSO_4$, and $FeCl_3$. In the following portions of the distillate, and in weak solutions containing less than 0·3 milligrm. of the acid in 100 c.c. of water, the above-mentioned reaction cannot be used, and the presence of HCy can only be detected by collecting the distillate in a condenser with a solution of silver nitrate. From alcoholic and aqueous solutions of potassium cyanide the hydrocyanic acid is liberated by passing a current of carbonic acid. The acid in this case is collected into a 5 per cent aqueous solution of potassium hydroxide; in this solution the acid is tested by Liebig's method. M. Gesechus has made some new experiments on the passage of the electric current through an electrolyte when there is a difference in the dimensions of the electrodes. The liquor used was a weak aqueous solution of sulphuric acid. One of the electrodes was a platinum crucible containing the liquor, and the other was a platinum wire, which was immersed in the liquor to various depths. Experiments proved that on connecting the crucible with the anode of a strong battery (20 to 30 cells), and placing the wire attached to the cathode into the liquor, that the current was strongest when there was a distance between the wire and the bottom of the crucible. When the wire touched the crucible no increase of current was remarked. New rules for Government orders of steel rails have been published. The presence of phosphorus in steel for rails is allowed in the following proportions:—

	Per Cent.
Phosphorus	0·05 0·06 0·06 0·08 0·08—0·09 0·09—0·10
Carbon ..	0·40—0·36 0·36—0·32 0·32—0·29 0·29—0·25

The Government has thus adopted a somewhat new and not well investigated metallurgical rule—the less carbon the steel contains the more may be the percentage of phosphorus in the metal. The water of the Neva, used by the inhabitants of St. Petersburg, is at present much injured by numerous works situated on the river. A new project has been devised by the town in order to supply water by an aqueduct from Dooderhoff, a village situated on the south of the town. 1000 parts of the Dooderhoff water contains 0·286 part of solids and 0·254 part of free and combined carbonic acid. The composition of the solid matter is the following:—

Calcium carbonate	59·23
Magnesium carbonate.. ..	34·14
Calcium sulphate	1·55
Magnesium chloride	0·83
Organic matter	2·80
Silica	0·49
Sodium chloride	traces
	99·04

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Obouchoff Steel Works.

NOTES AND QUERIES.

Concentrating Sulphuric Acid.—Can anyone oblige by informing me whether any better method of evaporating chamber-acid at 110° to 140° Twaddle than boiling in a leaden pan has yet become available?—B. O. V.

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(Prize Medal Paris Exhibition, 1867).

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THE CHEMICAL NEWS.

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THE CHEMICAL PROFESSION.

All our readers must be aware that the question of a professional organisation for chemists has been very fully debated both in our own columns and in some of our contemporaries, and that much difference of opinion prevails concerning the exact steps to be taken, although the necessity for such action is admitted by all concerned. Whilst, however, gentlemen of scientific eminence and established reputation are thus labouring to raise the status of themselves and their brethren, to exclude from the ranks of the profession all who are either morally or intellectually incompetent, and to win for chemistry and for those who live by its practical applications a more honourable position, it is painful to find that certain other persons are labouring diligently—and we fear successfully—in the very opposite direction. Correspondents have drawn our attention to circulars—apparently widely circulated—in which certain analytical practitioners offer to perform the determination of almost every element in whatsoever combination, not merely for a fixed charge, but for one ridiculously low. We have before us whilst writing a document of this kind, in which the advertiser offers to perform the "commercial analysis" of a soil for from five shillings to a guinea! Now if we call to mind the number of determinations which must be made to throw any useful light upon the agricultural capabilities of a soil, and the extreme accuracy required, we must declare that at such a scale of charges no one working carefully and conscientiously could earn the wages of a day-labourer. If analytical chemistry is to be exercised upon such terms we must advise students that stone-breaking is, of the two, the more respectable profession! Returning to the circular we find that a determination of nickel or cobalt will be made for five shillings, and one of mercury (or hydrargyrus, as it is here called) for the same sum. A quantitative determination of arsenic—for anything stipulated to the contrary in the body of a poisoned man or animal—can also be had at the above modest figure. What would be thought among legal practitioners of a solicitor who circulated a price-list for conducting all manner of cases, and who moreover descended in some instances to one-fifth or even one-tenth the usual charges? The cases, we maintain, are strictly analogous. The determination of an element is not a task which invariably requires the same amount of time and skill. It may be in one particular instance easy and simple, and in another it may be rendered tedious and difficult by the presence of other bodies.

Chemical practitioners who seek to obtain or extend a connection by under-bidding their colleagues sometimes profess to have secret methods which enable them to execute analyses with much more ease than can be done by any known process. But what, we ask, is said in the medical profession of any practitioner who boasts of secret methods which he refuses to submit to competent judgment? Is he not at once designated by a name more emphatic than pleasant? We are unable to see that secret methods are more trustworthy in chemistry than in medicine. Any commercial analysis may possibly lead to litigation, and what would judges or opposing counsel say both to and of an expert who, whilst swearing to certain results, wished to conceal the processes by which such results had been reached? We know how we should prompt counsel if we were engaged on the opposite side. We cannot help expressing a hope that analysts who issue such circulars may, on reflection, feel how the injury they are doing to the profession must in the long run rebound upon themselves, and that they will see the necessity of acting for the future in a manner less unworthy of gentlemen and men of science.

THE ACTION AT A HIGH TEMPERATURE OF ALKALI-WASTE ON MANGANESE CHLORIDE, AND THE SPONTANEOUS OXIDATION OF MANGANESE SULPHIDE WITH INCANDESCENCE.

By WATSON SMITH, F.C.S.

The following experiments were made during the year 1869, and the results may possibly be interesting to manufacturers and technical chemists, as well as from a theoretical point of view to some extent. A quantity of fresh alkali-waste was rapidly dried, and mixed with a due proportion of crude manganese chloride, obtained from the spent liquors from the stills for generating chlorine in the bleaching-powder process. This mixture was placed in a deep crucible with well-fitting lid, and exposed to a red heat over the gas blowpipe, or in a furnace. The mass soon began to fuse, and during the reaction which took place the bluish flame of burning sulphur made its appearance for a short time, issuing out between the lid and the crucible. In one or two cases the bottom of the crucible was fused out, the clay of the vessel being evidently acted upon by the ingredients. The mass in the crucible after the fusion was of a dark brown or black colour. The crucible with its contents was placed in a basin and boiled out with water repeatedly, and the solution with precipitate was thrown on a filter. A mixture of manganese sulphide with some brown oxide of manganese, and insoluble matters, was found on the filter, whilst the filtrate contained calcium chloride abundantly, with a little manganese sulphate, and undecomposed chloride. After washing, the residue on the filter was carefully dried in the water-bath, and pulverised finely, when, on slightly heating, the mass at once became incandescent and burnt like tinder. The bluish flame of sulphur slightly made its appearance, sulphur dioxide being disengaged to a small extent. Finally, a brown powder remained consisting of a mixture of manganese brown oxide, and manganese sulphate. This powder was treated with hot distilled water, filtered, and washed. Brown oxide of manganese remained on the filter, and the filtrate contained a considerable amount of manganese sulphate. The two by-products were thus divided into three bodies, all of which are at least to some extent useful, viz., calcium chloride, manganese sulphate, and brown oxide of manganese. The second was ignited with an equivalent weight of sodium chloride, the mass dissolved in water, and the not too concentrated solution set to crystallise, a crop of Glauber's salt was obtained. The third was treated with hydrochloric acid, when chlorine was liberally evolved. The sulphur dioxide evolved as above mentioned would, of course, be a useful product.

I have noticed recently a note by MM. de Clermont and H. Guiot in the *Comptes Rendus* for the 9th July, an abstract of which appeared in the Chemical News, vol. xxxvi., p. 61, to the effect that the authors have discovered that precipitated manganese sulphide, dried between blotting paper, and then over concentrated sulphuric acid *in vacuo*, when afterwards exposed to the air, becomes red-hot, and burns like tinder, a mixture of brown oxide of manganese and manganese sulphate being left behind. Now from as far back as the year 1869 this fact of the spontaneous oxidation of manganese sulphide with incandescence has been familiar to me, though I confess I have never before published the matter, and so far only as that is concerned are MM. de Clermont and Guiot in advance of me. I ought to say, however, that

working as I did, with a sulphide of manganese not quite pure, I found that the incandescence did not set in until after spreading out the powder on a plate, and sometimes gently warming.

If ferrous or ferric chlorides be fused in like manner with alkali-waste a mass consisting of calcium chloride and ferrous sulphide is obtained. The two bodies in the mixture are separated by treatment with water and filtration, ferrous sulphide being left on the filter. On igniting the ferrous sulphide, sulphide dioxide is evolved, and ferric oxide remains behind.

ON SOME NEW RESEARCHES ON THE METAL DAVYUM.

By SERGIUS KERN, St. Petersburg.

The weight of the davyum ingot was 0·27 grm. This ingot was dissolved in aqua regia, and the action of different reagents on the davyum chloride solution was more closely examined.

Potassium hydroxide gives a precipitate of a light lemon colour, which easily dissolves in acids, even in concentrated acetic acid. This hydrate of davyum dissolved in nitric acid yields on evaporation a brownish mass of a nitrate of davyum. By ignition the nitrate compound gives a blackish powder, probably the davyum monoxide. Acid solutions of davyum chloride are precipitated by yellow prussiate; in this case a brownish precipitate is obtained. Potassium cyanide dissolves readily davyum chloride; the solution being evaporated yields big prisms of a double cyanide salt of davyum and potassium. In this double salt the potassium may be replaced by many metallic elements. By passing through solutions of such salts hydrogen sulphide davyum-cyanic acid is obtained in the form of a crystalline red mass, which, on being even gently heated, is decomposed.

Hydrogen sulphide in davyum acid solutions gives a brownish precipitate of davyum sulphide; on being dried it turns black. This compound easily dissolves in alkaline sulphides, yielding probably sulpho-salts.

As I mentioned in my first communication on the new metal, the davyum chloride with potassium sulphocyanide gives a red colouration. Several metals give the same reaction, and as it was interesting to show that this reaction of davyum is not identical with the reactions of other metallic salts, the action of potassium sulphocyanide was more closely examined. Careful qualitative analyses showed no presence whatever of iron; no other metals were present, and the davyum was dissolved in aqua regia, the solution was evaporated, and the resulting mass of davyum chloride was re-dissolved in water. To this solution potassium sulphocyanide was added, and a deep red colouration was immediately obtained. Taking a concentrated hot solution of davyum chloride and mixing it with the above-mentioned reagent a red precipitate is obtained, which, on being dried over sulphuric acid, yields beautiful crystals of davyum sulphocyanide; if the same compound is dried quickly on a sand-bath a blackish mass is obtained, being the same salt, davyum sulphocyanide, as analyses showed. These reactions show that the davyum sulphocyanide may be obtained in two forms.

The davyum chloride was more closely examined. This salt is very soluble in water, alcohol, and ether. The carefully crystallised davyum chloride attracts moisture very difficultly; even after a long contact with the air it does not liquefy. On being heated on a gas blowpipe it yields the monoxide, which is soluble only in aqua regia. As platinum chloride, the correspondent salt of davyum with chlorides of potassium, thallium, and ammonium, yields double salts of a dark red colour insoluble in water and easily soluble in absolute alcohol. The double salt of sodium and davyum chlorides is nearly insoluble in water and alcohol, as the following table shows :—

	In 100 parts of—	
	Alcohol.	Water.
0°	0·05	0·09
20	0·08	0·11
40	0·10	0·14
70	0·07	0·10
100	0·06	0·08

This fact is very characteristic, as most of the sodium double salts of the metals of the platinum group are very soluble in water. Davyum chloride is supposed to be the only stable compound of chlorine and davyum, because on being carefully prepared the nearly neutral solution of davyum chloride, evaporated on a sand-bath, liberates abundant vapours of chlorine, so that I think that the second chloride may exist only in solution as the palladium chloride ($PdCl_4$).

Davyum sulphate is obtained by leaving davyum for a couple of hours in contact with boiling sulphuric acid. The salt is of a yellowish red colour and is nearly insoluble in water.

I made several new experiments on the specific gravity of the metallic davyum. The following are the results obtained. The temperature during the experiments was 24° C.

9·388
9·387
9·392

These numbers confirm my late experiments on the same subject very closely. The specific gravity then obtained was 9·385 at 25° C.

My friend, Engineer Alexejeff, is engaged in the determination of the atomic weight of the new metal. Some preliminary experiments show that the atomic weight is not 100 as it was first mentioned, but must be near to 154. The platinum ores contain not more than 0·045 to 0·035 per cent of davyum. Unfortunately the quantity of metallic davyum in hand is so small that it is impossible to commence serious experiments until new quantities of davyum can be liberated from the ores.

Obouchoff Steel Works.

ACTION OF SULPHUR AT HIGH TEMPERATURES UPON NORMAL PARAFFINS.

By S. CABOT, Jun.

Hoping to obtain a sulphur compound of the normal paraffins which might be decomposed with oxide of lead to an oxide, and perhaps be of use in the candle industry, I took for an experiment some pure heptane, C_7H_{16}, prepared by Prof. Schorlemmer, of Manchester, from petroleum. This was heated in a flask with a large excess of sulphur. The flask was connected with a return tube cooled with water, to prevent the heptane from distilling off and being lost. After five or six hours' heating this mass began to change in colour, and volumes of sulphuretted hydrogen were given off. By continuing the heating the paraffin was almost entirely decomposed. The remainder was examined and proved to contain no organic sulphur compound. The smell was very offensive, but not more so than the combined perfume of H_2S and heptane (petroleum spirit) would produce. The excess of C_7H_{16} was distilled off, and the solid residue was examined by dissolving the sulphur with bisulphide of carbon, which left a black powdery precipitate of carbon. Another portion was heated in a small retort until all the sulphur was distilled off; a black pulverulent residue of carbon was left.

From this experiment it is seen that sulphur at high temperatures decomposes heptane, forming H_2S and carbon. This, I have no question, is the case with all the other members of the group, and I therefore shall not attempt the formation of a sulphur compound of the heavier and solid paraffins.—*American Chemist.*

CHLORIDE OF COBALT-AMMONIUM.

By J. M. MERRICK, B.Sc.

I FIND that if a solution of chloride of cobalt and one of chloride of ammonium be mixed and set aside for some weeks to crystallise, a confused mass of crystals is obtained. The mass consists of chloride of ammonium (coloured purplish by the cobalt), and in this are imbedded large handsome crystals of chloride of cobalt. These crystals, when picked out and washed, give upon testing only mere traces of ammonia, no more than may reasonably be supposed to be mechanically included in the interstices of the crystal. No double salt appears to be formed in this way.—*American Chemist.*

SCHŒNBEIN'S TEST FOR NITRATES.

By F. H. STORER,
Professor of Agricultural Chemistry in Harvard University.

IN his important paper on the "Behaviour of Ozone towards Water and Nitrogen," Carius* remarks incidentally that he has not found the iodo-starch test for nitrates (employed in conjunction with zinc, as the reducing agent) a specially delicate one.

It is obvious that this test for nitrates cannot in the nature of things compare in delicacy with the similar test for nitrites, where the iodo-starch is added directly to the suspected liquid, after mere acidulation. A much smaller quantity of nitrite than of nitrate can always be detected by the above-mentioned test, since the zinc, or other reducing agent, which is made to act upon the nitrate in order that the iodo-starch reaction may occur, does not in any case change the whole of the nitrate into a nitrite and no other nitrogenous product. The zinc may fail, upon the one hand, to reduce the whole of the nitrate, while upon the other its action may go too far, so that a part of the nitrite, formed at first, through reduction of the nitrate, may be reduced in its turn and removed from the field of action. Some of the nitrate is always changed, withal, to an ammonium salt, and so destroyed in so far as the power of reacting upon iodo-starch is concerned.

These considerations have often been urged, and they are undoubtedly familiar to most chemists. But in the lack of a better, the iodo-starch test for nitrates has come into very general use, and has been held in high estimation. The remark of Carius must have struck scores of chemists, as it did myself, as extraordinary and hardly credible. It was neither consistent with Schœnbein's statement as to the delicacy of the test nor with the reputation which the test had acquired. I have thus been led to examine the matter somewhat attentively, and to subject the test anew to critical study. It appears from this examination that the lack of delicacy observed by Carius was due to the kind of manipulation employed by him, and that while his statement is doubtless literally correct, it fails to convey a just idea of the much higher degree of delicacy which is readily obtainable by applying the test in a somewhat different way.

Two methods of using the test were described by Schœnbein,† viz.: 1st, To add dilute sulphuric acid and iodo-starch paste directly to the nitrate solution and to stir the mixture with a zinc rod; or, 2nd, and better, as we must infer from Schœnbein's statement, to reduce the neutral solution of the nitrate in the first place by means of zinc or cadmium, thereafter to acidulate it with dilute sulphuric acid, and finally to add the iodo-starch paste. Both of these modifications have come into general use, but the second has been applied, perhaps, even more frequently than the first in cases where very small amounts of nitrates were to be sought for. It is, in fact, more delicate than the first method. Carius, however, in the experiments above referred to, employed the first modification and not the second.

For my own part, I find that the chief objection to the iodo-starch test for nitrates is by no means a lack of delicacy. The fatal defect of the test, as hitherto applied, is to be found in the fact that mere water, which is absolutely free from any contamination of nitrates or nitrites, on being treated with zinc or cadmium, as if to test it for a nitrate, will react upon iodo-starch precisely as if a trace of some nitrate had been dissolved in the water.

The explanation of this behaviour is not far to seek. The colouration of the iodo-starch is caused by peroxide of hydrogen which has been formed in the water by the action of the metal, according to the familiar experiment of Schœnbein,* in which peroxide of hydrogen is prepared by shaking zinc-amalgam in water and air.†

The amount of peroxide of hydrogen that is formed in the limited volume of liquid used, and under the conditions which ordinarily obtain when testing for a nitrate, is undoubtedly very small, but it is nevertheless sufficient to give a perfectly distinct reaction with acidulated iodo-zinc starch solution. This reaction is far too strong to admit of its being neglected, subtracted, or allowed for, when searching for traces of nitrates. Hence it happens that in highly dilute solutions of nitrate of potash it is impossible to detect the nitrate by means of iodo-starch as ordinarily applied, not because the products of the reduction of the nitrate by zinc, or the like, cease to act upon the iodo-starch, but because the reaction produced by these products is identical with that of the peroxide of hydrogen that is formed simultaneously with them, and which would be formed just as well in pure water totally devoid of nitrates.

Whenever the degree of colouration of the iodo-starch obtained in testing for a nitrate according to Schœnbein's method, is less intense than the tint obtainable from 0·0001 grm. N_2O_5 (= 0·000187 grm. KNO_3) in 50 c.c. water it is difficult to decide whether the colouration may not be wholly due to peroxide of hydrogen. It is easy, at all events, to obtain as much peroxide of hydrogen by boiling cadmium, zinc, or amalgamated zinc with mere water, as will give a reaction with acidulated iodo-zinc starch equal to that obtainable from 0·00005 grm. N_2O_5, or perhaps even more. The following experiments will illustrate this point:—

A. To 50 c.c. of pure water 0·00005 grm. N_2O_5 (in the form of 0·0000936 grm. of nitrate of potash) was added; the mixture was boiled five minutes with a piece of cadmium in a small flask, then cooled, transferred to a porcelain capsule, acidulated and tested with iodo-zinc starch.

B. The same experiment was repeated with pure water to which no nitrate had been added.

C. Same as A, with the exception that zinc was used instead of cadmium.

D. Same as B, with the exception that zinc was used instead of cadmium.

The four capsules were placed side by side under a darkened bell glass, and left to stand over night. On examination it appeared that while the contents of capsules B, C, and D seemed to be of one and the same depth of colour, the contents of capsule A were distinctly lighter coloured than those of either of the other dishes. These experiments were simultaneous, and care was taken that they should be strictly comparable one with another. Each experiment was conducted as if a nitrate were being tested for. Equal surfaces of metal, as nearly

* *Annalen der Chemie*, 1874, clxxiv., 14, note.

† See, for example, his paper in Fresenius's *Zeitschrift Analyt. Chemie*, 1862, i., pp. 14, 15.

* *Poggendorff's Annalen*, 1861, cxii., 288.

† Schœnbein has himself shown (*Journal für prakt. Chemie*, 1861, lxxxiv., 268) that peroxide of hydrogen is formed simultaneously with a nitrite, when the aqueous solution of a nitrate is treated with zinc or cadmium, as a preliminary to the application of the iodo-starch test, but he seems to have completely overlooked the fact that the presence of the peroxide would preclude the application of his test for nitrites, in cases where the solution to be examined contained only a small quantity of the nitrate.

it might be, were exposed to the action of the liquids in each instance.

Repetitions of these tests gave similar or analogous results. Sometimes the contents of one capsule in the series would become more or less strongly coloured than the rest, and at other times another; but everything went to show that by the method of testing traces of nitrate cannot be distinguished from the peroxide of hydrogen that is naturally formed in the liquid under examination. So, too, when amalgamated zinc was used instead of the simple zinc or cadmium. It is true, as Schœnbein* has said, that water which contains only $\frac{1}{10000}$ of nitrate of potash will colour iodo-starch blue, after having been shaken or boiled with bits of amalgamated zinc, filtered, and acidulated with sulphuric acid; but since water that is absolutely free from nitrates will do almost precisely the same thing, when similarly treated, the statement is of no value either as regards the delicacy of the test or the limit of its applicability.

Proof that the cause of the reaction in the water free from nitrates is really due to the presence of peroxide of hydrogen is readily obtained on testing the neutral liquid for that substance with a drop or two of a weak solution of ferrous sulphate† and the solution of iodo-zinc starch. The characteristic blue colouration of the iodo-starch will quickly appear when pure water that has been boiled with cadmium or with zinc has been subjected to this test, while no reaction is obtained, even after the lapse of many hours, when pure water that has not been in contact with a metal is similarly treated.

With pure water these results are constant and invariable, but it is noteworthy that, on testing in this way, samples of water taken from wells, and of rain water taken respectively from a brick and from a leaden cistern, no reaction for peroxide of hydrogen was obtained after simple boiling for five minutes with the cadmium, though on boiling with cadmium and then leaving the liquid to stand upon the metal for twenty-four hours a reaction for the peroxide was finally obtained with the rain water. So, too, when the pure water was tested in a somewhat different way by mixing it directly with the solutions of iodo-zinc starch and sulphate of iron and ammonia, and placing a piece of cadmium in the mixture, the blue colouration soon appeared, while no such colouration was observed when samples of rain or well water were tested in this way; far from becoming blue, the liquids soon acquired a rusty colour, as if from oxidation of the iron salt.

Care was taken to control the peroxide reactions by applying the test (ammonium-ferrous sulphate and iodo-zinc starch) to acidulated water that had not been in contact with cadmium or zinc, to acidulated and to neutral solutions of pure nitrate of potash, to neutral solutions of nitrite of soda, all made with pure water, and to the distillate from a solution of nitrite of soda that had been boiled with dilute sulphuric acid. But no trace of blue colouration was observed in either instance.

Corroborative evidence of the presence of peroxide of hydrogen in the water that had been boiled with cadmium was obtained as follows:—Two portions, each of 100 c.c., of pure water were taken. To one portion two-hundredths of a milligramme of nitrous acid was added, in the form of nitrite of soda, together with 2 c.c. of dilute sulphuric acid (1 : 4), and the mixture was boiled for ten minutes in order to expel the nitrous acid. The other portion was boiled with cadmium, as if it were to be tested for a nitrate, the cadmium was removed, the liquid was mixed with 2 c.c. of the dilute acid, and then boiled for ten minutes. Each portion was finally tested, when cold, with iodo-zinc starch. The second portion, viz., the one to which no nitrate had been added, speedily gave a reaction, but the first portion did not. After standing twelve hours in the dark, the first portion remained colourless, while the second portion was distinctly blue. In a word, the nitrous acid known to have been present in the first portion had been completely expelled by the boiling, while much of the peroxide of hydrogen in the second portion had remained intact.

The fact that highly dilute aqueous solutions of peroxide of hydrogen suffer but little decomposition at the temperature of boiling has often been insisted upon;* but less attention seems to have been paid to the equally important fact† that some of the peroxide goes forward, as such, with the vapour of water, and may be detected in the distillate. This volatility of the peroxide is a point of no little significance for the analyst, since it makes it much more difficult than would otherwise be the case to detect traces of nitrites in solutions suspected to contain them, as well as the peroxide. Contrary to the opinion expressed by Plugg,‡ it would be altogether useless, in delicate experiments, to apply, in the presence of peroxide of hydrogen, that method of testing for nitrites which depends upon the volatility of nitrous acid, viz., the distillation of the nitrite solution with a dilute acid and subsequent testing, with iodo-starch plus acid, for nitrous acid in the distillate. The following experiments will illustrate the importance of this consideration:—Two portions of pure water, each of 250 c.c., were taken, and one was distilled directly with acetic acid, while the other was boiled with cadmium for five minutes, and thereafter distilled with acetic acid, pains being taken to make the two experiments alike in all other respects. The first 50 c.c. of distillate were collected in each instance, and tested with iodo-zinc starch after acidulation. No reaction was obtained in the distillate from the mere water and acetic acid, while the distillate from the water that had been boiled upon cadmium became coloured in less than half an hour. Repetitions of this experiment gave similar results.

That only a part of the peroxide goes forward with the steam will be seen from the following trials:—Two separate 250 c.c. portions of pure water that had just been distilled off from a flask containing a mixture of zinc and spongy copper were boiled with cadmium, and a part of each of the liquids was tested directly with iodo-zinc starch plus acid, while the remainders were distilled with acetic acid, and the first 50 c.c. of distillate was subjected to the test in each instance. In both trials the portions tested directly gave a stronger colouration than was obtained in either of the distillates. In order to be sure that the acetic acid had no improper influence on these reactions, several portions of pure water were distilled with the acetic acid for a time, a fresh portion of the acetic acid was then added, and the next 50 c.c. of distillate was tested with iodo-zinc starch plus acid, but no reactions were obtained, although the mixtures were allowed to stand twenty-four hours after the application of the test.

It may be mentioned in this connection that the tendency of peroxide of hydrogen to be transported with the vapour of water may perhaps afford the true explanation of the cause of the presence of the peroxide in some of the solutions examined by Meissner in his "Untersuchungen über Sauerstoff, Hannover," 1863, pp. 94—110. Such transportation of the peroxide may account, moreover, for the presence of this substance in the outer or water tube of Schœnbein's and Meissner's (op. cit., p. 74) earlier experiments on the making of peroxide of hydrogen from peroxide of barium and sulphuric acid, without need of supposing that the "antozone" of these chemists had any part in the reaction.

With regard to the delicacy of the iodo-starch test for nitrates, supposing there were no interference from peroxide of hydrogen, it appears, as has been stated above,

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† Or, instead of simple ferrous sulphate, the double sulphate of protoxide of iron and ammonia may be used with advantage, as was suggested by Struve. (*Zeitschrift Analyt. Chemie*, 1869, viii. 112). Most of the tests described in the text were made with this latter salt. Fewer drops of a 1-100 normal solution of it were ordinarily used.

* Compare Gmelin—Kraut's "Handbuch der Chemie, 1872, i. (2te Abth.), p. 58.

† First recognised, I believe, by Schœnbein. See Will's *Jahresbericht*, 1866, p. 105.

‡ Fresenius's *Zeitschrift Analyt. Chemie*, 1875, xiv, 141.

that that method of procedure in which the nitrate is reduced by itself, as a separate, preliminary step, before the acidulation of the liquor or the addition of the iodo-starch, is decidedly preferable to the other system of adding the iodo-starch, the acid, and the reducing agent all at once to the nitrate solution. As Goppelsrœder* has remarked, it seems to be immaterial whether the nitrate solution be boiled for a few moments with the cadmium or zinc, or left to stand for some hours in the cold in contact with one of these metals; though the boiling will usually be found more convenient in practice.

It has been customary hitherto, in this laboratory, to proceed as follows, when testing for nitrates by Schœnbein's process:—100 c.c. of the suspected liquid were put in a small glass flask, together with bits of metallic cadmium and boiled for five minutes. When the liquid had become cold, half of it was transferred to a small porcelain dish, 1 c.c. of dilute sulphuric acid† was added to it, and finally 2 c.c. of iodo-zinc starch solution.‡ The capsule, with its contents, was then placed under a darkened bell-glass and examined at stated intervals. Tested in this way, a solution of nitrate of potash, containing 0·0005 grm. N_2O_5 in 50 c.c. water, gave an immediate colouration on being mixed with iodo-zinc starch plus acid, after having been boiled for five minutes upon cadmium; with a solution containing 0·0002 grm. N_2O_5 the blue colouration appeared about five minutes after the addition of the iodo-starch, and with a solution containing 0·0001 grm. N_2O_5 the colour began to appear in about eight minutes. The last-named quantity indicates very nearly the limit of applicability of the test, since the degree of colouration derivable from an amount of the nitrate any smaller than this could hardly be distinguished from that due to the peroxide of hydrogen that is obtained on boiling pure water upon cadmium or zinc. It is true that the colouration caused by the products of the reduction of a nitrate generally appears rather more speedily than the colouration produced by peroxide of hydrogen, but since the reaction of the peroxide often begins to show ten or fifteen minutes after the addition of the iodo-zinc starch and acid, and sometimes even sooner, no dependence can be placed upon mere rapidity in the appearance of the colouration as a means of distinguishing the nitrate from the peroxide. In case the mixtures are left to stand over night, or for a number of hours, after the iodo-starch has been added, this seeming advantage in favour of the nitrate solutions disappears; for (after long standing, the colouration due to peroxide of hydrogen is often as deep as that obtained from 0·00005 grm. N_2O_5, and the difference between this tint and that obtained from 0·0001 is by no means large enough to permit of distinguishing the one from the other with any certainty.

Results very different from the foregoing were obtained when 50 c.c. of the pure nitrate solution, mixed directly with 2 drops of the dilute acid and 2 c.c. of the iodo-zinc starch solution, were left to stand in contact with a rod of zinc, according to the method employed by Carius.* On proceeding in this way, a solution containing 0·01 grm. of N_2O_5 (= 0·01872 grm. KNO_3), in 50 c.c. of water gave a reaction almost immediately when the zinc was added; and a solution containing 0·005 grm. N_2O_5 (= 0·00936 grm. KNO_3) began to show a blue colouration at the lower end of the zinc rod in a few minutes, while in a solution containing 0·002 grm. N_2O_5 (= 0·00374 grm. KNO_3) no colouration could be perceived even after the lapse of two hours, though the liquid was examined at frequent intervals. On repeating this trial with 0·002 grm. N_2O_5 a similar result was obtained. 0·003 grm. N_2O_5 (= 0·005616 grm. KNO_3) in 50 c.c. water gave a very slight colouration at the lower end of the zinc rod after a comparatively short time. Trials similar to the above, in which amalgamated zinc was used instead of simple zinc, gave no better results, but rather worse, on the whole. Rods of cadmium appeared to be somewhat preferable to those of zinc, though not much.

It will be observed that the results of these tests are even less favourable than those obtained by Carius, since this chemist puts the limit of delicacy at 0·0015 grm. KNO_3 in 50 c.c. water. The following experiments, moreover, go to show that when the test is used in this manner the presence of trifling impurities in the solution to be examined may interfere with the reaction very decidedly and render the negative indications of the test untrustworthy even at the comparatively low degree of delicacy above mentioned. Thus, on repeating some of the foregoing trials and using rain-water to dissolve the nitrate, instead of the pure water previously used (see foot-note) less favourable results were obtained. A solution of the nitrate equal to 0·005 grm. N_2O_5, in 50 c.c. cistern water gave no reaction with the iodo-zinc-starch in the course of an hour. On repeating the trial with cistern-water that had just been boiled, a slight reaction was obtained, but the blue colour instead of increasing faded away after a time and disappeared. The proportion of acid employed to acidulate the mixture is not without influence upon the delicacy of the test, and it may well be that in order to obtain the best results a larger amount of acid is required than was used in the foregoing trials. The small quantity of the acid actually taken was chosen in order to conform to Carius's injunction that "the addition of but little acid is a condition of success." But it appeared once on repeating the trial with the nitrate solution, in pure water, that contained 0·005 grm. N_2O_5 in 50 c.c., that while no colouration of the iodo-starch had appeared after some time so long as only two drops of sulphuric acid had been added, the reaction soon set in on the addition of two more drops of the acid.

(To be continued.)

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* *Poggendorff's Annalen*, 1862, cxv., 128.

† The dilute sulphuric acid is prepared by mixing one volume of oil of vitriol with three volumes of pure water, boiling the mixture for an hour, and finally adding enough pure water to replace that which has evaporated.

‡ The solution of iodo-zinc-starch is prepared as follows, after Kubel-Tiemann, "Anleitung zur Untersuchung von Wasser," Braunschweig, 1874, p. 140: Rub 4 grms. of starch in a porcelain mortar with a little water, and pour the smooth, milky liquid, little by little, into a boiling solution of 20 grms. pure commercial chloride of zinc in 100 c.c. of distilled water. Continue to boil the mixture until as much of the starch as possible has dissolved, and the liquid has become almost clear, taking care meanwhile to replace the water that evaporates. Dilute with distilled water; add 2 grms. of pure, dry, commercial iodide of zinc; bring the volume of the liquid to a litre, and pour it into a tall cylinder to settle. After several days, decant the clear liquid and keep it in the dark in well-closed bottles.

Pure water is obtained as follows: Enough crystallised permanganate of potash is dissolved in rain-water to colour the liquid strongly; the mixture is left to stand for twenty-four hours, and then transferred to a copper still. A lump of lime is added and the mixture is distilled slowly, the first fractions of distillate being rejected. The rest of the distillate is re-distilled in a glass flask, upon lime, and the new distillate is rejected until it ceases to show ammonia when tested with Nessler's reagent. Such water is free from ammonia and from nitrates, and when tested for nitrites with iodo-zinc-starch, plus acid, it will not show any trace of colouration at the end of an hour, and will seldom show any appreciable tinge of colour when the mixture is left to stand over night, though on standing for twenty-four hours a faint shade of colour will usually appear. I have commonly attributed this tendency to give a reaction to the presence of an infinitesimal trace of nitrite, but it is not impossible that it may be due to peroxide of hydrogen that has been formed by means of the copper of the still. It would undoubtedly be better, when possible, to perform all the distillations in glass vessels. However that may be, such water is abundantly pure enough for the purposes of this research. For cases where absolute purity is essential, water that will not give any reaction for nitrites may be prepared, by acidulating with acid sulphate of soda the pure water obtained as above (from glass vessels) and re-distilling it in a glass flask. Free nitrous acid being readily volatile will go forward in the first portions of distillate from the acidulated water, so that, by rejecting a considerable fraction of the distillate at first and saving the water that comes over later, it is no very difficult matter to obtain water that is perfectly free from all three of the nitrogen compounds now in question as well as from peroxide of hydrogen.

Most well-waters, it should be said, are, if anything, rather better than rain-water for preparing a pure product.

By making the mixture of permanganate and water alkaline with lime instead of a caustic alkali, the nitrous compounds which almost always contaminate the latter are avoided.

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* *Annalen der Chemie*, 1874, clxxiv., 11

NOTICES OF BOOKS.

Eleventh Annual Report of the Warden of the Standards on the Proceedings and Business of the Standard Weights and Measures Department of the Board of Trade for 1876-7. London: G. E. Eyre and W. Spottiswoode.

It appears that standard "gas-measures" have been supplied to the Lord Mayors of London and Dublin and to the Lord Provost of Edinburgh as far back as 1860. But unfortunately "The Sale of Gas Act" makes no provision for the use of these models, and it is a matter of regret that such instruments should have been sent to these cities without some instructions as to their use. In the same cities the working standard gas-measures used by the inspectors in the actual testing of gas-meters have not been verified for seventeen years. Hence, as the report very justly remarks, "the accuracy of any results obtained from them is doubtful." It appears further, that the inspector of gas-meters is not required by law to examine into the accuracy of the index. Yet after such a partial examination the instrument is stamped as correct! "Three recent instances have been reported to this department in which consumers of gas were charged for gas much in excess of what they had consumed owing, as it was subsequent accidentally discovered, to the inaccuracy of the index only. In one instance a 'three-light' meter registered five times more than was really consumed; in a second instance a '300-light' meter registered three times more than was actually consumed; and in a third instance, Mr. W. B. Davis, of Torquay, complains that his meter, though stamped as correct, had been found to register 86,000 feet in excess." It is surely time that some more efficient and trustworthy method of measuring gas should be devised. Had the defects of the present meter told against the vendor we will venture to say that it would have been long ago discontinued.

In another portion of the report the "rude and antiquated method of teaching weights and measures" still pursued in schools is justly complained of. It appears that in arithmetical treatises children are still taught weights and measures which are illegal and obsolete. But a still greater misfortune is that a number of such illegal weights are still used in actual business, and that a person removing from one part of England to another finds himself a complete stranger to the standards of the locality, and has often to pay dearly for instruction. Would it be much harder to learn once for all the metric system?

Elementary Chemistry: a Text-Book for Beginners, Designed as an Introduction to Barker's Chemistry. By S. F. PECKHAM, A.M., Professor of Chemistry, University of Minnesota. Louisville: J. P. Morton and Co.

THIS is an elementary treatise on chemistry drawn up in the form of a series of dialogues between a certain Uncle Louis and his nephews and nieces, who are supposed to be desirous of turning their vacations to account by the acquisition of knowledge not included in the school curriculum. The bulk of the matter, as might be expected, is neither better nor worse than what may be found in others of the scarcely numerable introductory works on chemistry which have appeared in America and in England. The descriptions are clear and the experiments are simple, easy of performance, and well calculated to illustrate the main truths of the science.

The chapter on dyeing and calico-printing, however, contains certain passages to which exception may fairly be taken. Thus, the reader is informed that the difference between "fast" and "loose" colours is that the former are deposited inside the tubes of the fibre, whilst the loose colours are merely stuck on outside. The distinction is therefore made to appear as depending, not on the nature of the colours themselves, but on the method of their application. This is a serious error. In the first place not all fibres are tubular. Secondly, the distinction between fast and loose colours is one of degree, not of kind. Lastly, if we take a fast and a fugitive colour, say indigo and carthamine, and expose them both to the sun under precisely similar circumstances, and without the intervention of any fibre at all, we shall find the former remains unchanged, whilst the latter quickly fades. We certainly should not select the so-called pigment style of calico-printing—the fixation of insoluble colours by means of albumen, &c., as a characteristic example of "loose colours." Nor can we subscribe to the statement that "almost all muslin de laine is printed with albumen." We do not, however, wish it to be understood that all the sections treating of the applications of chemistry to the arts and manufactures are equally impaired with inaccuracies.

The Metallurgical Review. Published Monthly by DAVID WILLIAMS, 83, Reade Street, New York. No. 1, September, 1877.

THIS is a notable specimen of American literary enterprise, a magazine of 100 pages, admirably printed on superior paper, and with illustrations. It contains essays on the following subjects:—"The Mechanical Treatment of Metals," by Prof. R. H. Thurston; "New Iron District of Ohio," by E. C. Pechin; "Analyses of Bessemer Steels;" "Siphon Tap in Lead Smelting," by C. Kirchoff, Jun.; "Danks's Furnace at the Millvale Works," by John J. Williams; "Blast-Furnace Fumes;" "Cinder in Puddled Iron;" "On Steel," by William Metcalf, C.E.; "Stopping-up of Regenerators in the Siemens Furnace;" "Studies of Elemental Iron in its Modifications," by Prof. Henry Wurtz;" "Iron Making in New South Wales;" "Chlorine Compound in the Blast-Furnace;" "Protecting the Lining of Blast-Furnaces," by J. D. Weeks; "Silicon in Bessemer Pig;" "Reduction of Ores in the Bessemer Converter;" "Use of Alloys of Silicon and Manganese in Casting Steel," by Sergius Kern; "Nails from Old Rails;" "A New Metal;" "Determination of Phosphorus in Iron, Steel, and Ores," by A. J. Preusse; "Mixtures for Tempering Small Steel Articles;" "Novel Joint Stock Company."

Our space does not permit special criticism of any of the above articles. Those we have read are carefully written in a philosophic spirit that is well suited to a magazine of the high pretensions of this review. There is an absence of the trade advertisement class of articles that commonly abound in technological journals. The nearest approach to these is the article on the Danks's furnace by the superintendent of the Millvale Works. This, although a vigorous vindication of a special device, is free from any efforts at puffing, and perfectly fair and legitimate in its partizanship.

The fact that such a magazine as this can be launched in the United States with prospect of success indicates a degree of technological intelligence and activity on that side of the Atlantic which is well worthy of the serious attention of our own iron masters and other practical metallurgists. It is one among other signs of the times that may serve as a warning to those who imagine that "the rule-of-thumb" will continue to enable us to retain our manufacturing supremacy in the contest with our Transatlantic cousins, whose supplies of raw material, coal, and ores are so much greater than our own, and who, in addition to this, appear to be passing us in the all-important effort to bring the great discoveries of modern science to bear upon the development of industrial operations.

The publishers of this review evidently aim at a circulation extending beyond the limits of the United States, as the subscription price of five dollars per annum includes domestic or foreign postage. They announce that "the indexing of the volumes will be very complete,"

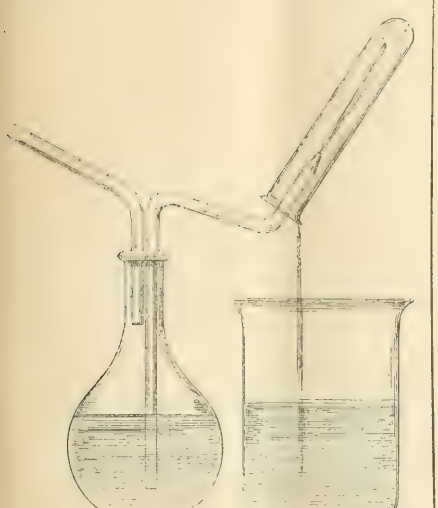
also that "each number will be printed from *electrotype plates*, and orders for back numbers or complete sets from the beginning can always be fulfilled."

CORRESPONDENCE.

IMPROVED WASH-BOTTLE.

To the Editor of the Chemical News.

SIR,—Noticing a article on "Simple Laboratory Manipulations" in the CHEMICAL NEWS (vol. xxxvi., p. 57), I thought I would enclose you a sketch of a form of wash-bottle which I have found extremely useful in washing precipitates, &c., from test-tubes, beakers, &c. The improvement consists simply in bending up the jet end of the



tube at about an inch and a half from the extremity; so that while the bottle is held in the ordinary upright position a vertical jet of water can be directed into a test-tube inverted over a beaker to receive the washings, as shown in the sketch.—I am, &c.

E. H. JOHNSON.

New York, August 22, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 8, Aug. 20, 1877.

Characters of Flames charged with Saline Dust.—M. Gouy.—Flames produced by a detonating mixture of coal-gas and of air charged with saline dust are distinguished by several characteristics from the coloured flames ordinarily observed in spectral analysis. (1.) Certain salts, such as copper and calcium chlorides, &c., which commonly give rays proper to the undecomposed salt, show here nothing similar and are entirely dissociated; thus calcium nitrate and chloride and copper nitrate and chloride give respectively the same spectrum. In case of the latter metal the spectrum of the chloride reappears if the flame is charged with hydrochloric acid, or if it is cooled by any means soever. Thus the reducing flame burning in a current of coal-gas is surrounded with a blue envelope, which shows the bands of the chloride; in like manner, if the flame contains a large excess of air, its point is coloured a pure blue and gives exclusively the spectrum of the chloride. A cold body—as, e.g., a glass rod—if introduced into the flame is surrounded with a blue halo which displays the bands of the chloride. If this spectrum is seen when operating in the ordinary manner it is due to the cooling produced by the platinum wire. Strontium, and especially barium chloride, are not entirely dissociated under similar circumstances. The same method is suitable for the study of the spectra produced by oxidising or reducing flames. It is merely requisite to charge the mixture with an excess of air, or to cause the reducing flame to burn in a current of coal-gas. The detonating mixture is made perfectly homogeneous by causing it to pass through a receiver containing 15 litres. We observe, then, that the spectra of the metals do not disappear suddenly at a certain composition of the gaseous mixture, but become gradually weaker as the excess of air augments. Thus the quantity of the metal which remains free is a continued function of the excess of oxygen in the flame—a function very different for different metals. It is the same with the oxides: at least with the oxide of copper, the only one which gives a beautiful spectrum, and is easily adapted to these experiments. With an excess of air it gives a green flame, whose spectrum is well-known. The flame on being rendered reductive turns reddish; it still shows the same spectrum, but the red bands predominate. Whatever may be the cause of this remarkable change there is no doubt of the existence of oxide of copper in vapour in this flame, which reduces solid oxide of copper. It has been established by M. H. Sainte-Claire Deville that such flames contain free oxygen. These observations show the necessity of operating with flames homogeneous and not cooled in order to obtain definite results which may be of some value in sidereal spectroscopy. We see, for instance, that the absence of the rays of the chlorides in the solar spectrum is not the necessary proof of an excessive temperature. (2.) The author has shown (*Comptes Rendus*, lxxxiv., p. 231) that the surface of the interior cone which forms the base of every homogeneous flame possesses a peculiar emissive power when the detonating mixture holds in suspension saline dust, and gives the same rays as the induction-spark striking upon a solution of the same salt: to the list of metals which display this phenomenon may be added sodium, tin, bismuth, chrome, and osmium. He has studied in detail the structure and the variations of this surface, regulating the flame in such a manner that the height of the cone might differ little from the diameter of its base. When the detonating mixture does not hold saline dust in suspension the surface of the cone gives merely the rays of carbon, and, if the composition of the mixture varies, undergoes great variations of colour, which are generally described in a manner not very exact. When the flame contains neither an excess of air nor of gas, and is at its maximum temperature, the surface is blue; with an excess of air it becomes violet, and its spectrum is almost continuous. With an excess of gas it is at first green, then blue, and less brilliant; this is generally the case with the Bunsen lamp. At the same time it grows dull, its margins become indistinct, and when the flame grows bright at the point it is entirely effaced. A very fine metal wire, supported upon a stronger wire, and introduced into the interior cone, enables us to observe the distribution of

temperature there. We see that when the flame has not a great excess of gas the temperature seems to augment abruptly on the surface of the cone. With a large excess of gas the wire becomes reddish at a distance of 1 m.m. and more from the surface. Hence if we place in suspension in the combustible mixture pulverised cupric chloride the salt is volatilised before reaching the surface of the cone, throws out rays for a moment, and is then dissociated as the temperature increases. We see then appear a blue surface, equidistant from the former, and between the two a dark space. The new surface is more brilliant than the other, and shows the bands of the chloride; the dark interval may exceed 1 m.m., and diminishes simultaneously with the increase of the gas. With the acetate of copper the surface of the cone becomes rose-coloured, the flame being somewhat reddish. Beneath it is a slender green layer, which appears due to the cupric oxide volatilised in the mixture very hot, but not combined. As for the rose-coloured surface, it has the colour which the oxide of copper takes in a reducing flame. With a great number of other salts, as those of lime, strontia, &c., the surface of the cone if the gas is in excess loses its peculiar colour and takes that of the flame, upon which it forms a light pattern. It is the same with salts such as chloride of cobalt, which gives a white flame full of very small solid particles. The author has given a great lustre to the spectrum of the inner cone by placing twenty small flames in a straight line in the axis of the collimator of the spectroscope. In this manner he has examined the spectrum of platinum chloride. This salt gives at the base of the flame a spectrum of bands not seen when operating in the common manner, and which the spark does not show. This spectrum is formed of sixteen bands, grouped two and two like those of copper chloride, but larger and more remote from each other. Their right margin (on the violet side) is very distinct, and they fade away on the right. Some of them are furrowed with equidistant black rays. We see, also, some fainter nebulous rays in groups of two or three. This spectrum extends from the red to the violet. Some bands, not the strongest, are still visible above the inner cone. This spectrum is due to platinous chloride, which, according to MM. Troost and Hautefeuille, is re-formed at an elevated temperature. All these observations agree in indicating the existence, at the base of the flame, of a very thin stratum where the temperature is much higher than in the flame itself—a result which theory renders probable.

Researches on the Chromates.—M. A. Etard.—Already noticed.

Justus Liebig's Annalen der Chemie,
Band 187, Heft 1 and 2.

Hydrogenisation of Benzol and its Homologues.—F. Wreden.—This paper consists of three chapters, the first on "Hexahydro-isoxylol"; the second on the "Hexahydro Derivatives of Toluol, Benzol, and Cymol"; and the third on the general results of the experiments undertaken. It appears that the benzol hydrocarbons are incapable of taking up more than 6H, and that a direct transition from benzol and its homologues to the homologues of methan with an equal number of carbon atoms in the molecule is impracticable. Hence we must admit the existence of a series of homologous hydrocarbons of the general formula $C_6H_{12-m}R^m$, which approximate very closely in their properties to the homologues of methan.

Tetra-hydro-isoxylol, and the Constitution of the Camphoric Acids.—F. Wreden.—The isomeric camphoric acids may be considered as the dicarbon acids of two isomeric iso-carbons, tetra-hydro-iso-xylol and Moitessier's hydrocarbon, C_8H_{14}. The optically inactive modifications may be regarded as isomeric tetra-hydro-iso-xylol-dicarbonic acids, $C_6H_8(CH_3)_2(CO_2H)_2$. The latter as substitutes of hexa-hydrobenzol must approximate in their behaviour to Baeyer's hydro-mellithic acids and to hexahydro-phthalic acid.

New Organic Acid Occurring in Nature.—C. Stahlschmidt.—The acid in question, the polyphoric, occurs in certain fungi of the family *Polyporus*, growing on the stems of diseased or dead oaks. The empirical formula is $C_9H_7O_2$. This acid has a yellow colour, and is so completely insoluble in water that the slightest trace of a soluble polyporate in water renders the liquid turbid on the addition of salt or of soluble sulphuric acid. In virtue of this property the soluble polyporates may serve as indicators in alkalimetry, the turbidity serving instead of the usual change of colonr. With all bases it forms well defined salts, of which the soluble ones, those of the alkalies and ammonia, form deep purple solutions. On heating polyporate of potassium to redness in a combustion-tube along with zinc-powder benzol was obtained, which was identified by its conversion into nitro-benzol and thence into aniline.

Communications from the Laboratory of the University of Halle.—These consists of a paper on the "Ammonia Derivatives of Benzo-phenon and Aceton," by M. Pauly, a long and interesting paper, to which justice could not be done in an abstract; a memoir on the "Reducing Action of Bone-black at a Low Temperature," by W. Heintz. In this essay the author states that he was formerly of the opinion that animal charcoal if carefully lixiviated and recently ignited could not precipitate platinic chloride. In the course of certain researches, where he had frequent occasion to act upon platinum double salts with animal charcoal, he became convinced of the contrary, reduction really taking place. He ascribes this action to the hydrogen, which even at the most intense heat cannot be entirely expelled from charcoal. The Halle communications further comprise two papers by the same authors, one on the "Decomposition of Nitroso-triacetonamin by Acids," and one on the "Formation of Phoron from Nitroso-triacetonamin."

Action of Phosphoric Pentachloride upon Anhydrous Tungstic Acid.—Nicolae Teclu.—The compounds resulting from the reaction are tungstic hexachloride and phosphoric oxychloride.

Three Dichlorobenzoic Acids, and certain Derivatives of Trichloro-toluol.—Dr. Richard Schultz.—This memoir is not adapted for useful abstraction.

Affinity of Sulphur and Oxygen for Metals.—Dr. Otto Schumann.—The author remarks that Thomsen has endeavoured to measure the respective affinities of various elements by the amount of heat liberated on their combination. Another method for the determination of affinities has been the investigation whether an element could more or less easily be substituted for another in its compounds. Both these methods are liable to give erroneous results, since physical changes often accompany the chemical action. Thus a part of the matter present may become insoluble or be volatilised, and may thus escape from further participation in the reaction. A second physical influence is the presence of a third body which does not participate in the decomposition, as we find in the so-called action of contact. The formation of sulphide on the action of hydrogen sulphide upon a metallic oxide may arise from two causes—either the affinity of the metal for sulphur may be greater than for oxygen, or the affinity of the hydrogen for oxygen may be greater than for sulphur. The latter case only occurs when the affinity of hydrogen for oxygen is greater than that of the metal for oxygen, consequently when—

$$(H_2 \nearrow O) > (M \nearrow O) - \nearrow,$$

being Thomsen's symbol for affinity, or only in case of metals whose oxides are decomposed by hydrogen at elevated temperatures. In case of the metals of the alkalies and alkaline earths, as well as of Mg, Al, Cr, Mn, the formation of a sulphide can never be a direct proof of the greater affinity of sulphur. If watery vapour acts upon a sulphide with formation of oxide we have in this fact a direct proof of the superior affinity of oxygen. The same

conclusion may be legitimately drawn when oxide is formed on the action of hydrogen upon a sulphate. When, however, a sulphide is produced under the same circumstances no direct conclusion can be drawn. The author then gives at some length an abstract of the earlier literature of the subject.

Hypo-phosphoric Acid.—T. Salzer.—An investigation in detail on the formation, properties, and combinations of hypo-phosphoric acid. The author assigns to the hypothetical anhydrous acid the formula PO_4 and to the hydrate $PO_4.2HO$.

Modification of the Method of Dumas for the Determination of Vapour Densities.—J. Habermann.—This paper requires the accompanying engraving.

Communications from the Chemical Laboratory of the University of Greifswald.—These communications consist of a paper on para-dibrom-sulpho-benzolic acid, by Dr. H. Borns.

Beiblatter zu den Annalen der Physik und Chemie, No. 1, 1877, Band 1, stück 1.

Observations on the Deviation of the Lines in the Solar Spectrum.—C. A. Young (*Sillim. Journ.*, xii., 321).—The author infers from his experiments that the sun revolves at the rate of 1·42 miles per second, whilst direct observation gives only 1·2. This difference Young explains by the hypothesis that the body of the sun has a distinct movement within the chromosphere.

Experimental Investigations on the Magnetic Rotation of the Plane of Polarisation. (III. Dispersion of Planes of Polarisation in Case of Rays of Different Wave-Lengths.)—H. Becquerel.—Taken from *Comptes Rendus*, lxxxiii., p. 125, 1876.

Observation of the Ultra-red Portion of the Spectrum with the Aid of Phosphorescent Phenomena.—E. Becquerel.—From *Comptes Rendus*, lxxxiii., 251.

Efflux of Mercury from Capillary Tubes of Glass.—F. Villari (*Cim.* xv., 263, and xvi., 23).—The mercury may escape either in drops or in a stream. Poiseuilles law applies in the former case but not in the latter. (See *Pogg. Ann.*, cxl., 367.) The coefficient of friction assumes different values according to the manner in which the capillary tubes have been cleaned.

Action of a Moving Dielectric upon an Electric.—B. Felici (*Cim.*, xv., 73).—Beneath a plate of aluminium suspended horizontally from a long thin silver wire a horizontal glass plate was caused to revolve. As long as the aluminium plate was not electric it followed the glass plate but slightly, in consequence of the friction of the air. As soon as it is electrified it revolves twice or thrice on its axis in the direction of the revolution of the glass disc.

Electro-chemical Researches on the Benzol Derivatives.—F. Goppelsroeder (*Bull. de la Soc.de Mulhouse*, 1876, May 11, and *Comptes Rendus*, lxxxi., 944, 1875; and lxxxii., 1199, 1876).—Already noticed.

Thermo-electric Properties of Sodium and Potassium at Different Temperatures.—A. Naccari and M. Bellati (*Atti del Inst. Ven.*, ii.).—Not suitable for abstraction.

Action of a Copper Zinc Element upon Chlorates and Perchlorates.—Mr. Eccles.—Taken from the *Journ. of the Chem. Soc.*, clii., 856, 1876.

New Peroxide of Manganese Battery.—G. Leclanché.—From the *Comptes Rendus*, lxxxiii., p. 54.

Description of the Intensity Compass.—J. Stamkart *Arch. Neerl.*, xi., 197, 1876).—Already noticed.

New Dynamo-magnetic Phenomenon.—MM. Treve and Durassier.—From the *Comptes Rendus*, lxxxiii., 857.

Elasticity and Flexibility of Ice.—J. J. Bianconi (*Mem. de Acc. di Bologna*).—At lower temperatures ice is perfectly brittle, but about zero it is capable of considerable deflection if submitted to a gradual pressure.

Friction of the Ether.—M. Hicks.—From *Nature*, xiv., 144.

Seiches of the Swiss Lakes.—F. A. Forel.—From the *Phil. Mag.*, ii., 447.

Proceedings of the London Physical Society.—From *Nature*, xv., p. 91.

Gazzetta Chimica Italiana, Anno vii., 1877, Fas. vii.

The Expansion, the Capillarity, and the Viscosity of Melted Sulphur.—G. Pisati.—The specific volume of virgin sulphur decreased from 0·000282 to 0·000010 during a progressive elevation of temperature from 125° to 159·5°, and increased again to 0·000210 on a further rise to 245°. From 125·6° to 190·6° the capillary elevation rose from 6·63 millimetres to 8·09. The viscosity of virgin sulphur reaches a minimum about 157°, augments then rapidly, reaches a maximum about 195°, and afterwards declines again.

Sulph acids of Normal Butyl-benzine.—Luigi Balbiano.—Normal sulpho-butyl-benzinic acid is obtained by treating normal butyl-benzine with an excess of a mixture of equal weights of ordinary concentrated sulphuric acid and of Nordhausen acid. The salts and acid derivatives of this compound are briefly described.

Coloured Reaction of Urea.—Ugo Schiff.—If to a solution of urea in about three parts of the aqueous solution of furfurol are added a few drops of concentrated hydrochloric acid, the liquid on heating assumes a magnificent violet colour, and in a short time coagulates into a black solid mass. The alcoholic solution gives rise to the same phenomenon.

An Acetylen Urea.—Ugo Schiff.—The product of the reaction of oxalic aldehyd upon urea may be considered as acetylen urea.

Particular Decomposition of Boric Acid.—Ugo Schiff.—About 25 grms. of triethylic borate were preserved in a phial, with a ground glass stopper, in a very damp place. In the neck of the bottle there occurred a fissure, through which a diffusion of aqueous vapour seems to have become established. After about two years, during which time the phial was untouched, the edge of the fissure was found covered with boric hydrate, whilst the contents of the bottle were transformed into a colourless, transparent, hard, vitreous mass.

Researches on the Production of Salicylate of Iron.—Dr. S. Barilari.—The author finds that by the prolonged action of salicylic acid at a boil a proto-salt is formed, which remains in this condition as long as nascent hydrogen is evolved.

Propyl-isopropyl-benzine, and on the Propyl-benzoic and Homo-terephthalic Acids, the Products of its Oxidation.—E. Paterno and P. Spica.—Not suitable for useful abstraction.

Revue Universelle des Mines, May and June, 1877.

Value of Belgian Iron Ores as compared with those of Foreign Origin.—M. A. Habets.—The foreign ores here spoken of are chiefly derived from France. The memoir, which is far too bulky for abstraction, and which has been "crowned" by the Association of Engineers of the School of Liége, contains some interesting information on the behaviour of the phosphorus compounds in iron ores.

Analysis of Saltpetre intended for the Manufacture of Gunpowder.—A. Fresenius determines the moisture by heating to incipient fusion. The amount of insoluble matter is found by dissolving 100 grms. in hot

water, and collecting the insoluble matter on a small tared filter. The filtrate is acidulated with pure nitric acid, and the chlorine is determined gravimetrically with nitrate of silver. In this case the volumetric method does not give satisfactory results. In order to determine lime, magnesia, and soda, 100 grms. of saltpetre (to which about 1·5 grm. potassium chloride is added in order to decompose sodium nitrate) are dissolved in 100 c.c. of hot water, and the solution is then poured into half a litre of pure alcohol at 96 per cent, taking care to stir continually. The crystalline precipitate is collected on a filter previously well washed, and fitted with an aspirator, and washed with alcohol. The alcoholic liquid is submitted to distillation. The residue is dissolved in a little water, precipitated a second time with alcohol, and distilled again. A third precipitation with alcohol yields a liquid which contains all the lime, magnesia, and soda, and so small a quantity of potassic salts that their separation from the soda is practicable. This is only true when the sample contains no sulphate, as is generally the case; otherwise, the alcohol would occasion the precipitation of sulphate of lime. After having expelled the alcohol from the last liquid by evaporation, the nitrates are completely converted into chlorides by repeated evaporations with hydrochloric acid; the lime is then precipitated with a few drops of ammonic oxalate, and in the filtrate the magnesia is thrown down with a small quantity of pure phosphate of ammonia in presence of ammonia. The filtrate is heated to expel ammonia, mixed with a few drops of ferric chloride, and then with ammonia or carbonate of ammonia till the reaction is faintly alkaline. Iron and phosphoric acid are thus removed. The filtrate is evaporated to dryness, the ammoniacal salts are expelled by heat, the potassa is separated by platinum chloride, and the sodium is determined as chloride. The composition of a sample of saltpetre analysed by this method was found to be—

Nitrate of potassa (by diff.) ..	99·8124
,, ,, soda	0·0207
,, ,, magnesia	0·0093
,, ,, lime	0·0006
Chloride of sodium..	0·0134
Insoluble matters	0·0210
Moisture	0·1226
	100·0000

NOTES AND QUERIES.

Clarifying Gelatin.—Can any correspondent tell me how to clarify gelatin without white of egg so as to make a thick transparent jelly, not to eat.—A. S.

Graduation of Thermometers.—Will you kindly inform me of a colouring material for the graduation of chemical thermometers, which will stand moderate heat and wear; that employed by the makers becoming useless almost immediately.—DELTA.

NOTICE.

The STUDENTS' NUMBER of the CHEMICAL NEWS will be published on Friday next, September 21st. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the education, who have not yet forwarded the necessary information to our Office for publication in that Number, will confer a favour by sending it with the least possible delay.

Methylated Spirits.—David Smith Kidd Licensed Maker, Commercial Street, Shoreditch, N.E Also FINISH, FUSEL OIL and RECT. NAPHTHA.

F. W. HART, Manufacturer and Dealer in Apparatus and Chemicals for Scientific Pursuits. Laboratory Fitter and Furnisher Photographic Apparatus and Materials 8 and 9, KINGSLAND GREEN (WEST SIDE), LONDON.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works Manchester.

Important Sale of Leasehold Interest in the GREENFIELD ALKALI WORKS, HOLYWELL, Flintshire, together with the whole of the Plant and Machinery, as a going concern.

Messrs. CHURTON, ELPHICK, and CO. have been instructed to SELL BY AUCTION, at the Grosvenor Hotel, Chester, on Tuesday, September 25th, 1877, at One for Two o'clock p.m. punctually, in one lot, and subject to such conditions as will then be produced, the valuable LEASEHOLD INTEREST in the above Premises, under a Lease for a term which expires on 25th December, 1892 (determinable by the Lessees or their assigns in 1878 or 1885 on six months previous notice being given to the Lessors), at a rental of £250 per annum; together with the option given by such Lease to purchase the reversion in fee expectant on the determination of the term thereby granted for the sum of £5000; and together also with the whole of the extremely valuable PLANT, MACHINERY, and other Effects, which have been fixed and put upon the premises at a very heavy cost, including Steam Engines, Boilers, Lead Chambers, Iron Tanks, lorry, materials and other articles and things, schedules of which have been prepared and may be obtained as mentioned below.

The above premises are very extensive, and well adapted to carry on a large business; they have a frontage to an excellent road, and are close to the Holywell Station on the Chester and Holyhead Railway.

The premises may be viewed on applying to H. A. Cope, Esq., Solicitor, Holywell; and further information, and copies of the schedules above referred to, may be obtained on application to him; to Messrs. Churton, Elphick, Roberts, and Richardson, the Auctioneers, at their Mart in Foregate Street, Chester; or to Messrs. Broomhead, Wightman, and Moore, Solicitors, Bank Chambers, George Street, Sheffield

THE SUSSEX CHEMICAL WORKS, Near Shoreham. With Possession.

Messrs. FULLER, HORSEY, SON, and CO. are instructed to SELL BY AUCTION, at the Mart, Tokenhouse Yard, on Thursday, 27th September, at One precisely, the LEASE, PLANT, AND MACHINERY of the Sussex Chemical Works, together with the Contracts and Goodwill.

The Property is situate opposite Kingston-by-Sea, in the Parish of Lancing, on the River Adur, close to the mouth of the Harbour, and occupies an area of about 2¾ acres. The Buildings comprise brick-built boiler-house, 32 feet by 25 feet, lean to in rear; brick- and timber-built ammonia-shed, 50 ft. by 28 ft.; lime-shed; brick-built laboratory; smith's shop; anthracene-shed, 52½ ft. by 23 ft.; store-house; pitch-chamber; pitch-bed; spacious yard; timber pontoon and landing-stage. The Plant and Machinery includes 5 wrought-iron stills, with 15 lb. lead-lined absorbers, brick seatings, furnace work, and chimneys; 3 tar stills (two 1500 and one 2400 gallons), with brick seatings and chimney-stacks and condensers; steam-pumps; 2 Cornish steam-boilers; 4 lead-lined dipping-vats; range of 52 anthracene straining-bags; hydraulic press with 10-inch ram and pumps; iron store-tanks; and the necessary plant for carrying on the distillation of tar and the manufacture of sulphate of ammonia.

There is a wharf opposite on the bank of the river, having direct communication with the London, Brighton, and South Coast Railway. Vessels of 200 tons can load alongside the Works. Contracts and agreements are running with the Brighton and neighbouring Gas Companies for the whole of their tar and gas-liquor on most favourable terms, and there are other contracts for coals, pitch, &c., all of which will be included in the purchase.

The Property is held on Lease for an unexpired term of about 18 years at the very low rent of £32 per annum.

The loose tools and utensils, barges, tanks on rails, trolleys, &c., to be taken by a purchaser at a fair valuation.

May be viewed till the sale by orders which may be had of the Auctioneers. Particulars may be had of G. D. Hare, Esq., Solicitor, 18, Old Broad Street, E.C.; of Messrs. Ingledew, Ince, and Greening, St. Benet's Chambers, Gracechurch Street, E.C.; of Messrs. C. Browne, Stanley, and Co., 25, Old Jewry, E.C.; of Messrs. Cape and Harris, 8, Old Jewry, E.C.; at the Mart; and of Messrs. Fuller, Horsey, Son, and Co., 11, Billiter Square, London, E.C.

BURGOYNE, BURBIDGES, CYRIAX, & FARRIES, MANUFACTURING AND OPERATIVE CHEMISTS, 16, COLEMAN STREET, E.C. (Prize Medal Paris Exhibition, 1867).

Manufacturers of every description of Pure Acids, Chemicals, and Reagents for Analytical Purposes and Scientific Research.

Sole Agents for C. A. KAHLBAUM, Berlin.

Price Lists and Special Quotations upon application.

WILLIAM HARVEY, Manufacturing Chemist, Tar and Ammonia Distiller, OFFICES: CATTEDOWN, PLYMOUTH.

Maker of Benzole, Toluole, Solvent and Burning Naphthas, Creosote Oils of all kinds, Naphthaline, Anthracene, Pitch, Carbolic Acid, Sulphate of Ammonia, &c., &c. NAPHTHA, LIGHT OIL, &c., PURCHASED AT MARKET RATES.

THE CHEMICAL NEWS.

Vol. XXXVI. No. 923.

UNIVERSITIES AND COLLEGES.

UNIVERSITY OF LONDON.

Candidates for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this examination is £2.

The Examination will be held on Monday, January 14th, 1878. It is conducted by means of Printed Papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects:—1. Latin. 2. Any two of the following Languages:—Greek, French, and German. 3. The English Language, English History, and Modern Geography. 4. Mathematics. 5. Natural Philosophy. 6. Chemistry.

The Papers in Latin and Greek will contain passages to be translated into English, with questions in Grammar and in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected. A separate paper will be set containing questions in Latin Grammar, with simple and easy sentences of English to be translated into Latin.

The papers in French and German will contain passages for translation into English, and questions in Grammar, limited to the Accidence.

The Latin subjects for 1878 and 1879 are—

For January, 1878:—*Livy*, Book II.
For June, 1878:—*Ovid*, Epistolæ ex Ponto, Book II.
For January, 1879:—*Cæsar*, De Bello Gallico, Books III. and IV.
For June, 1879:—*Cicero*, De Senectute, and the First Speech against Catiline.

Special stress is laid on accuracy in the answers to the Grammar questions, and on the correct rendering of English into Latin.

The Greek subjects for 1878 and 1879 are—

For January, 1878:—*Homer*, Iliad, Book X.
For June, 1878:—*Xenophon*, Hellenics, Book II.
For January, 1879:—*Homer*, Odyssey, Book XIV.
For June, 1879:—*Xenophon*, Anabasis, Book III.

Candidates may substitute German for Greek.

The Questions in Natural Philosophy are of a strictly elementary character; they include Mechanics, Hydrostatics, Hydraulics, Pneumatics, Optics, and Heat.

The Examination in Chemistry is—Chemistry of the Non-Metallic Elements; including their compounds—their chief physical and chemical characters—their preparation—and their characteristic tests.

A Pass Certificate, signed by the Registrar, will be delivered to each Candidate who applies for it, after the Report of the Examiners has been approved by the Senate.

If in the opinion of the Examiners any Candidates in the Honours Division of not more than Twenty years of age at the commencement of the Examination possess sufficient merit, the first among such Candidates will receive an Exhibition of thirty pounds per annum for the next two years; the second among such Candidates will receive an Exhibition of twenty pounds per annum for the next two years; and the third will receive an Exhibition of fifteen pounds per annum for the next two years; such exhibitions are payable in quarterly instalments, provided that on receiving each instalment the Exhibitioner declares his intention of presenting himself either at the two Examinations for B.A., or at the two Examinations for B.Sc., or at the First LL.B. Examination, or at the Preliminary Scientific and First M.B. Examinations, within three academical years* from the time of his passing the Matriculation Examination.

Under the same circumstances, the fourth among such Candidates will receive a prize to the value of ten pounds in books, philosophical instruments, or money; and the fifth and sixth will each receive a prize to the value of five pounds in books, philosophical instruments, or money.

Any Candidate who may obtain a place in the Honours Division at the Matriculation Examination in January is admissible to the First B.A. or to the First B.Sc. Examination in the following July. But such Candidate will not be admissible to the Second B.A. or to the Second B.Sc. Examination in the ensuing year, unless he has attained the age of eighteen years.

Several important changes have been made in the regulations relating to the Degrees in Science. These revised regulations relating to the *First* B.Sc. Examination will come into force at the Examination in July, 1877. Candidates presenting themselves at the *Second* B.Sc. Examination in October, 1877, will be allowed an option between the old and the revised regulations.

First B.Sc. Examination.

The First B.Sc. Examination will commence on Monday, July 16, 1878.

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this Examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The Examination embraces the following subjects:—Pure and Mixed Mathematics, Inorganic Chemistry, Experimental Physics, and General Biology.

Examination for Honours.

Any Candidate who has passed the First B.Sc. Examination in all its subjects may be examined at the Honours Examination next following the First B.Sc. Examination at which he has passed for Honours in (1) Mathematics, (2) Experimental Physics, (3) Chemistry, (4) Botany, and (5) Zoology; unless he has previously obtained the Exhibition in Pure and Mixed Mathematics at the First B.A. Examination, in which case he will not be admissible to the Examination for Honours in that subject; or unless he has previously obtained the Exhibition at the Preliminary Scientific (M.B.) Examination in either of the subjects which are common to it with the first B.Sc. Examination, in which case he will not be admissible to the Examination for Honours in that subject.

Candidates for Honours in Chemistry will be examined in Inorganic Chemistry, treated more fully than in the Pass Examination. In addition, they shall be examined practically in Simple Qualitative and Quantitative Analysis. This Examination, which will consist of six hours' examination by printed papers and of six hours' practical work, will take place on Thursday and Friday in the same week with the Examination for Honours in Mathematics, commencing on each day at 10 a.m.

* By the term "Academical Year" is ordinarily meant the period intervening between any Examination and an Examination of higher grade in the following year; which period may be either more or less than a Calendar year. Thus, the interval between the *First* Examinations in Arts, Science, and Medicine, and the *Second* Examinations of the next year in these Faculties respectively, is about sixteen months, while the interval between the Second B.A. Examination and the M.A. Examination of the next year, or between the Second B.Sc. Examination and the D.Sc. Examination of the next year, is less than eight months. Nevertheless, each of these intervals is counted as an "Academical Year."

In the Examination for Honours, the Candidate, not being more than 22 years of age at the commencement of the Pass Examination, who most distinguishes himself in Chemistry or Experimental Physics, will receive an Exhibition of £[illegible] per annum for the next two years.

Second B.Sc. Examination.

The Second B.Sc. Examination will commence on Monday, October 22nd, 1877.

Candidates for this Examination are required to have passed the First B.Sc. Examination at least one academical year previously.

The Fee for this Examination is £5.

The regulations are framed with the view of allowing the candidate to bring up *any three* of the following nine subjects:

1. Pure Mathematics.
2. Mixed Mathematics.
3. Experimental Physics.
4. Chemistry.
5. Botany, including Vegetable Physiology.
6. Zoology.
7. Animal Physiology.
8. Physical Geography and Geology.
9. Logic and Psychology.

It is understood the amount of proficiency expected in each of the three subjects chosen will be that which the candidate might attain by the steady devotion to it of about one-third of the sessional work of a diligent student.

Examination for Honours.

Any Candidate who has passed the Second B.Sc. Examination, and has not previously passed the Second B.A. Examination, may be examined at the Honours Examination next following the Second B.Sc. Examination at which he has passed, for Honours in (1) Mathematics, (2) Logic and Psychology, (3) Experimental Physics, (4) Chemistry, (5) Botany, (6) Zoology, (7) Physiology, (8) Physical Geography and Geology; provided that he shall have gone through the Pass Examination in the corresponding subject or subjects immediately before. And any Bachelor of Arts who has passed the Second B.Sc. Examination may under the same conditions be examined for Honours in one or more of the above mentioned subjects, unless he have previously obtained a Scholarship at the Second B.A. Examination in either of the first two of those subjects, in which case he shall not be admissible to the Examination for Honours in that subject.

The examination for Honours in Chemistry will take place on Monday and Tuesday in the second week after the conclusion of the Pass Examination; on Monday by printed papers (chiefly on Organic Chemistry), and on Tuesday by practical exercises in Simple Qualitative and Quantitative Analysis.

The candidate, being not more than 23 years of age, who most distinguishes himself in Chemistry, will receive £50 per annum for the next two years, with the style of University Scholar.

Doctor of Science.

The examination for the Degree of Doctor of Science takes place annually within the first twenty-one days of June, and the examination in each branch occupies four days.

No candidate is admitted to the examination for the Degree of D.Sc. until after the expiration of two Academical Years from the time of his obtaining the Degree of B.Sc. in this University, unless he shall have passed the Second B.Sc. Examination in the First Division at least two Academical years subsequently to having passed the first B.Sc. Examination, in which case he shall be admitted to the examination for the Degree of Doctor in Science at the expiration of *one* Academical Year from the time of obtaining his B.Sc. Degree.

The Fee for this Examination is £10.

Examination in Subjects relating to Public Health.

A Special Examination is held once in every year in subjects relating to public health. It commences on the second Monday in December.

No candidate is admitted to this Examination unless he has passed the Second Examination for the Degree of Bachelor of Medicine in this University at least one year previously; nor unless he shall have given notice of his intention to the Registrar at least two calendar months before the commencement of the Examination.

The Fee for this Examination is £5.

Candidates are examined in the following subjects:—

Chemistry and Microscopy, in relation to the examination of Air, Water, and Food.

Meteorology and Geology, as far as they bear on the duties of Health Officers, viz.:—General knowledge of Meteorological Conditions; Reading and Correction of Instruments. General knowledge of Soils; their Conformation and Chemical Composition.

Vital Statistics, in reference to the methods employed for determining the Health of a Community; Birth-rate; Death-rate; Disease-rate; Duration and of Expectancy of Life. Present amount of Mortality, and its causes, in different Communities.

Hygiene.—General principles of Hygiene. Special topics:—Soil. Construction of Dwellings. Conservancy of Cities. Unhealthy Trades. Supply of Food to Cities, and Examination of Food. Disposal of Sewage. Water-supply.

Medicine, in reference to the origin, spread, and method of prevention of Diseases generally, but especially those of the Epidemic class.

Sanitary Engineering, as far as regards the arrangements connected with Water-supply, Sewerage, and Ventilation. A knowledge of the reading of Plans, Sections, Scales, &c.

Sanitary Law, as far as it relates to the duties of Officer of Health. A knowledge of the powers given under the various Sanitary Acts, as defined in the Instructions issued by the Local Government Board, and of the methods of procedure in special cases.

The Examination, which is both written and practical, extends over four days.

Gilchrist Scholarships.

1. A Scholarship of the value of Fifty Pounds per annum, and tenable for three years, is annually awarded to the highest among those candidates at the June Matriculation Examination who have been approved by the Principal of University Hall as fit to be received into that Institution with a view to the prosecution of their studies in University College for Graduation in one of the four Faculties of the University of London; provided that such Candidate pass either in the Honours List or in the First Division.—Particulars may be obtained on application to the Principal of University Hall, Gordon Square, W.C.

2. A similar Scholarship is annually awarded to the Candidate from the Royal Medical College, Epsom, who at the June Matriculation Examination stands highest among the Candidates approved by the Head Master of that Institution, and who passes either in the Honours List or in the First Division; on condition of his prosecuting his studies during the tenure of his Scholarship with a view to Graduation in one of the four Faculties of the University of London.—Particulars may be obtained on application to the Secretary of the Royal Medical College, 37, Soho Square, W.

3. A similar amount is annually offered to Candidates intending to pursue, at Owens College, Manchester, their studies for Graduation in one of the four Faculties of the University of London; a single Scholarship of Fifty Pounds per annum for three years being awarded to the highest of those Candidates at the June Matriculation Examination who shall have been previously approved by the Principal of Owens College, provided that he pass in

the Honours Division; or, in case no Candidate should so pass, two Scholarships, each of Twenty-five Pounds per annum, being awarded to the two Candidates as aforesaid who shall stand highest in the First Division.—Particulars may be obtained on application to the Principal of Owens College, Manchester.

Particulars of the Colonial and Indian Scholarships may be obtained on application to the Secretary of the Gilchrist Educational Trust, University of London, W.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—W. Odling, M.A., F.R.S.

Professor of Mineralogy.—N. S. Maskelyne, M.A., F.R.S.

Demonstrator of Chemistry.—J. Fisher, M.A.

Analyst in Sanitary Laboratory.—W. F. Donkin, M.A.

Every Student must reside in one or other of the Colleges or Halls, or in licensed lodgings, for a period of three years, passing at least two examinations in Arts, and one in either Mathematics, Natural Science, Law, Modern History, or Theology, when, if he obtain a first, second, or third class, he can take his B.A. Degree; if he do not gain such honour he has to pass a third examination in *Literis Humanioribus*.

The instruction in Natural Science is carried on at the Museum, where there is practical instruction in Physics, Chemistry, Anatomy, and several other departments of natural science, together with courses of lectures and of practical instruction and work, by the several professors.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other colleges, by competitive examination in Natural Science.

More detailed information may be obtained from the University Calendar; from the professors; from E. Chapman, Esq., M.A., Frewin Hall; and from the Sub-Librarian in the Radcliffe Library or the Museum.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

Jacksonian Professor of Natural and Experimental Philosophy.—J. Dewar, M.A.

Demonstrators.—J. W. Hicks, M.A., W. J. Sell, B.A., and H. J. H. Fenton.

The Student must enter at one of the Colleges, or as a Non-collegiate Student, and keep terms for three years by residence in the University. He must pass the previous examination in Classics and Mathematics, which may be done in the first or second term of residence, or, through the Oxford and Cambridge Schools Examination Board, or through the Senior Local Examinations, before commencing residence. He may then proceed to take a Degree in Arts, either continuing mathematical and classical study, and passing the ordinary examinations for B.A., or going out in one of the Honour Triposes.

The scholarships, ranging in value from £20 to £80 a year, are chiefly given for mathematical and classical proficiency. Scholarships are given for Natural Science in Trinity, St. John's, St. Peter's, Clare, Christ's, Sidney, Pembroke, Caius, and Downing Colleges; the examinations being at Easter, and in June and October.

The Chemical Laboratory of the University is open daily for the use of the Students. The Demonstrator attends daily to give instructions.

Non-collegiate Students are allowed to attend certain of the College Lectures and all the Professors' Lectures, and have the same University status and privileges as the other Students. They are under the superintendence of the Rev. R. B. Somerset, Orford House, Cambridge, from whom further information may be obtained.

The following are the Lectures on Chemistry for the ensuing Academical Year:—

Michaelmas Term, 1876.

General Course, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Oct. 15.

Spectroscopic Analysis, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 1.30 p.m. Begin Oct. 15.

Analysis, by the Professor and the Demonstrators of Chemistry. Daily. Begin Oct. 8. Also at St. John's College, by Mr. Main. Begin Oct. 16.

Physical Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Oct. 16.

Elementary Organic Chemistry, by Mr. Main, at St. John's College, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Oct. 16.

Volumetric Analysis, by Mr. Apjohn, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin Oct. 17.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin Oct. 15.

Lent Term, 1877.

General Course continued, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Jan. 30.

Analysis, by the Professor or Demonstrators of Chemistry. Daily. Begin Jan. 21. Also at St. John's College, by Mr. Main. Begin Jan. 31.

Organic Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Jan. 31.

General Course, begun by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Jan. 31.

Non-metallic Elements, by Mr. Apjohn, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin Feb. 1.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin Feb. 1.

Easter Term, 1877.

Some Special Department, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin May 2.

Analysis, by the Professor or Demonstrators of Chemistry. Daily. Begin May 6. Also at St. John's College, by Mr. Main. Begin May 2.

Elementary Chemistry, by the Demonstrator of Chemistry, on Tuesdays, Thursdays, and Saturdays, at 3 p.m. Begin May 3.

General Course concluded, by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin May 3.

Elementary Organic Chemistry and Analysis, by Mr. Apjohn, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin May 1.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin April 30.

UNIVERSITY OF DUBLIN.—TRINITY COLLEGE

The Chemical Laboratory will re-open on October 1st, 1877. During the vacation a new Hall has been added to the Laboratory, whereby working accommodation for one hundred Students is provided.

The University Professor of Chemistry, Dr. Emerson Reynolds, assisted by the Demonstrator of Chemistry Mr. Early, conducts the undermentioned Courses of Laboratory instruction:—

The First Course of Practical Chemistry.—Michaelmas Term:—Qualitative Analysis and the Use of the Spectroscope. Hilary Term: Volumetric and Simple Gravimetric Analysis. Trinity Term: Organic Preparations and Analysis.

Students can also attend the Professor's Lectures on General Chemistry, and repeat most of the experiments performed in the Theatre.

This Course terminates on the last day of June.

The Second or Advanced Course includes instruction in the higher branches of Experimental and Analytical Chemistry, and in Methods of Research. Students who take out this Course are free to devote their chief attention to the study of special departments of Chemistry as applied to Arts and Industries.

Summer Course of Practical Chemistry for Medical Students.—This Course commences on the first Monday in April and terminates on the 30th of June following. Students experiment in the Laboratory from 2 to 4 o'clock on Tuesdays, Thursdays, and Saturdays.

Special Courses.—Students can enter at any time throughout the academic year for short terms of Laboratory instruction in Medical or Pharmaceutical Chemistry, or in the Methods of Analyses of Water, Air, &c., for Sanitary Purposes.

Lectures in Medical and Pharmaceutical Chemistry.—Dr. Reynolds lectures at 2 o'clock on Tuesdays, Thursdays, and Saturdays, from the, 1st of November to the 31st of March following.

All the classes are open to extra-Academic Students.

SCIENCE AND ART DEPARTMENT OF THE COMMITTEE OF COUNCIL ON EDUCATION, SOUTH KENSINGTON,

AND

ROYAL SCHOOL OF MINES, JERMYN STREET.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes were awarded, held at all places on complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

The following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are given at South Kensington:—

Chemistry, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Inorganic Chemistry, commencing October 1, 1877. A Course of Thirty Lectures on Organic Chemistry, commencing January 14, 1878. Fees—Lectures on Inorganic Chemistry, £4; Lectures on Organic Chemistry, £3; together, £6.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Monday, October 1, 1877. The Laboratories at South Kensington Museum are now used for the instruction of the Pupils of the Royal School of Mines.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month.

Physics, by Professor Frederick Guthrie, F.R.S. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures.* The Course will commence on October 1, 1877. Fee for Lectures and Laboratory work, £10.

Metallurgy, by Dr. Percy, F.R.S. The Course will consist of about Fifty Lectures, commencing on October 22, 1877.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the Student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the Student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a Student who has not furnished satisfactory proof that he is able to obtain accurate results.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accommodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the institution. Those for the ensuing Session include Geology, Natural History, Metallurgy, and Physics.

Exhibitions, Scholarships, and Prizes.

There are various Exhibitions, Scholarships, and free admissions attached to the School. They are as follow:—

Royal Exhibitions.

There are nine Royal Exhibitions to the Royal School of Mines, Jermyn Street, of the value of £50 per annum, entitling the holders to free admission to all the lectures and the chemical and metallurgical laboratories at the Royal School of Mines, to be held from year to year for three years, on the condition that the holder attends the courses regularly during those years, complies with all the rules laid down for his guidance, and passes the examinations required for the associateship of the school.

Free Admissions.

A free admission, conferring the privilege of attending all Lectures and Examinations without the payment of fees, is offered to any person who obtains a Queen's Gold Medal at the annual May Examinations of the Science and Art Department.

Royal Scholarships.

Two Scholarships, of fifteen pounds each, are given to the Students who shall stand highest on the list of those who have passed their Examinations for the first year; and a Scholarship of twenty-five pounds to that pupil who has gained the greatest number of marks in the examinations of the first two years.

KING'S COLLEGE.

(Department of Engineering and Applied Science.)

Professor of Chemistry.—C. L. Bloxam, F.C.S.
Demonstrator.—W. N. Hartley, F.C.S.
Assistant Demonstrator.—J. M. Thomson, F.C.S.

I. For Students intending to devote themselves to Medicine, Pharmacy, or Scientific Chemistry, or to take a degree in Medicine or Science in the University of London. A course of between sixty and seventy Lectures, by the Professor, commencing in October and terminating in March. Inorganic Chemistry, October till January. Organic Chemistry, February and March. On Monday, Wednesday, and Thursday, from 10.15 till 11.15. Fee, £8 8s. for the course, or £11 11s. perpetual attendance.

II. For Students intending to devote themselves to Engineering, Manufacturing Chemistry, Mining, Scientific

* A detailed account of the Laboratory Instruction in Physics will be found in the Students' Number of the CHEMICAL NEWS for 1875 (No. 824).

Chemistry, Commerce, Agriculture, Manufactures, Military Science, the Civil Service, and for those who are studying Chemistry for the sake of general information and as part of a liberal education. A Course of between fifty and sixty Lectures, by the Professor, carried on during the whole academical year. This Course is of such a character that Students may enter, without serious disadvantage, at the commencement of either of the College Terms. On Tuesday and Friday, from 10.20 till 11.20. Fee, £3 3s. a term, or £8 8s. for the year.

III. For Students who have any Examination in prospect, or who require general guidance in their Chemical studies. A Course of ten or twelve Lectures in each College Term, by the Assistant Demonstrator. On Saturday, from 11.15 till 12.15. Fee, £1 1s. for each term.

EVENING CLASSES.

For Students who are preparing for any Examination, or who require a general knowledge of Chemistry applicable to any pursuit.

A. A Course of about forty Lectures, by the Demonstrator, commencing in October and terminating in March. On Monday and Thursday evenings, from 7 till 8. Fee, £1 11s. 6d. for the Course.

B. A Summer Course of about ten Lectures, in April, May, and June. On Monday evenings, from 6.30 till 7.30. Fee, £1 1s. for the Course.

PRACTICAL CHEMISTRY.

For the study of Chemical Analysis of Inorganic and Organic Substances, as far as it is required in most Examinations. This Course is also preliminary to the study of Practical Chemistry in general.

Each Student works independently in the Laboratory, which is open in October, November, December, January, February, March—On Tuesday evening, from 7 till 9 p.m. Fee, £2 2s. for the Course.

II. May, June, July—On Monday, Tuesday, Wednesday, and Thursday, from 10.15 till 12.15 a.m. Fee, £5 5s. for the Course.

III. Each College Term—On Tuesday and Friday, from 10.20 till 11.40. Fee, £4 4s. per Term.

LABORATORY OF ANALYTICAL AND EXPERIMENTAL CHEMISTRY.

For the study of all branches of Practical Chemistry.

Each Student works independently in the Laboratory, which is open during all College Terms, on every day (except Saturday) from 10 till 4, and on Saturday, from 10 till 1. Fees, Experimental and Analytical Chemistry —One month, £4 4s.; three months, £10 10s.; six months, £18 18s.; nine months, £26 5s.

UNIVERSITY COLLEGE.

FACULTY OF SCIENCE.

Chemistry.—Professor Williamson, Ph.D., F.R.S.
Assistant Professor.—Charles Graham, D.Sc.

A. GENERAL COURSE.

Lectures daily (except Saturday) from 11 to 12 a.m., up to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the whole Course of Lectures, £7 7s.; for the First or Second Half Course separately, £4 4s.; for the Second Half, when the first has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise Class, £2 2s.

The instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by the Assistant Professor.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

Organic Chemistry commences in the second week in February, and occupies five Lectures weekly till about the end of March.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the Tutors of the Class. At the same time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

B.—ANALYTICAL AND PRACTICAL CHEMISTRY.

I. *Birkbeck Laboratory*.

The Laboratory and offices are open daily from 9 a.m. to 4 p.m., from the 3rd of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees, for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials.

II. *Summer Courses*.

1. *Elementary Course*.—About forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May.

Fees, including the cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

2. *Senior Course*.—This Course consists of twenty Lessons of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May.

Fees, including cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

UNIVERSITY COLLEGE, BRISTOL.

Professor of Chemistry.—E. A. Letts, Ph.D., F.R.S.E.
Assistant Lecturer.—W. W. J. Nicol, M.A.

Scholarships.

The following Scholarships will be offered in October:—

One Chemical Scholarship of the value of £25, tenable for one year.

Subjects of examination;—1st. A qualifying examination in the subjects required for the General Scholarships. 2nd. A Special Competitive Examination in Chemistry, both written and practical.

Three General Scholarships of the value of £15 each, tenable for one year.

The successful candidates for these General Scholarships will be required to attend at least three subjects of Lectures and Classes at the College.

The First Term will commence on the 9th of October and end on the 20th of December, 1877. The Second Term will commence on the 9th of January and end on the 4th of April, 1878. The Third Term will commence on the 25th of April and end on June 28th, 1878.

Inorganic Chemistry.

This Course will consist of Three Lectures a week, and will be continued during the First and Second Terms. They will be devoted to a consideration of the Theory of Chemistry, Chemical Physics, and Descriptive Inorganic Chemistry. In treating of the various substances under the latter heading, special attention will be given to their applications in the arts and manufactures. Fee £3 3s.

Laboratory Instruction.

The College Laboratory will be open daily at 10 a.m. Instruction will be given in the Laboratory in all branches of Practical Chemistry, including Qualitative and Quantitative Inorganic and Organic Analysis, the preparation of Chemical Products, and Inorganic and Organic Research, special facilities being afforded to those who desire to study Practical Chemistry, as applied to the different processes employed in the Arts and Manufactures. Each Student will be required to provide, at his own expense, a set of ordinary apparatus at a cost of about £5. The cost of material for original research must also be paid by the student requiring it.

Fees per Session: Students working 6 days per week, £15 15s.; 3 days per week, £10 10s. Per Term:—Students working 6 days per week, £7 7s.; 3 days per week, £4 4s. Per month:—Students working 6 days per week, £3 3s; 3 days per week, £2 2s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

Chemical Department.

Professor of Chemistry.—A. H. Church, M.A., Oxon.

The Collegiate year is divided into two Sessions, one beginning in February and ending in June, the other beginning in August, dividing in October, and ending in December.

During each Session the following Courses are given:—

36 Lectures on Inorganic Chemistry.
36 Lectures on Organic Chemistry.
36 Lectures on Agricultural Chemistry.
36 Laboratory Lessons in Chemical Manipulation.
36 Laboratory Lessons in Qualitative Analysis.
36 Laboratory Lessons in Quantitative Analysis.

The College Laboratory is open every day, except Saturday, from 9 a.m. till 5 p.m.

Advanced Students have the privilege of working at all times when the Laboratory is not occupied by other classes.

THE YORKSHIRE COLLEGE, LEEDS.

Professor of Chemistry.—T. E. Thorpe, Ph.D., F.R.S., F.C.S.

On October 23, 1877, the Foundation Stone of the New Buildings of this College will be laid by the Archbishop of York.

The Textile Industries Department, for which the Clothworkers' Company have given £10,000, will be the first section taken in hand. The promises of donations are now nearly £60,000, besides an income of £1000 per annum from endowments.

Lecture Courses.

1. General Course on Inorganic and Organic Chemistry—Monday, Tuesday, Wednesday, and Thursday, at 4 p.m., from October to the end of March. Fee for the Course, £4 4s.

2. Lectures on Laboratory Practice and Chemical Calculations—Thursday, at 10 a.m., during the First and Second Series. Fee, £1 1s.

3. Lectures on the Chemistry of the Non-Metals—Saturday, at 12 a.m., during the First and Second Terms. Fee, 10s. 6d.

Laboratory Courses.

The College Laboratory will be open daily from 9 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it will close at 1 p.m.

Fees for the Session—Students working six days per week, £17 17s.; four, £13 13s.; three £11 11s.; two, £8 8s.; one, £4 4s.

Class in Practical Chemistry, Saturday mornings, from 9 to 12, during First and Second Series. Fee £1 11s. 6d.

Practical Chemistry for Medical Students.—On Monday and Wednesday (hours 9 to 11 a.m.), from May to the end of July.

Scholarships.

The Cavendish Scholarship. Value £50 per annum, tenable for one year. Awarded for investigations made by the Candidates in any branch of Natural Science taught in the College.

The Salt Scholarship. Value £20 per annum, tenable for two years.

Akroyd Entrance Scholarships. Value £25 per annum, tenable for three years. Intended for the encouragement of the study of Natural Science. One of these Scholarships will be awarded annually, if in the opinion of the Examiners any Candidate shall possess sufficient merit.

The Clothworkers' Company Scholarships. Four Scholarships, each of the value of £25 per annum, and tenable for one year. Each Scholar will be required to attend regularly the Lectures and Courses of instruction given in the First and Second Years' Course of the Department of Textile Industries at the discretion of the Instructor.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.

*Professor of Chemistry.*A. Freire-Marreco, M.A. *Demonstrator*—J. T. Dunn, Assoc. Phys. Science.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it closes at 1 p.m. *Laboratory Fees.*—Students working six days per week, £5 5s. per term; alternate days, £3 3s.; one day per week, £1 1s.

Arrangements for Laboratory work in the evening and during vacation will be made.

Courses of Study.—Students will be distinguished into Regular and Occasional. Regular Students will be required to follow such a course of study in the subjects professed in the College as will enable them to pass the Examinations for the title of Associate in Physical Science. Occasional Students will attend such classes as they may select.

The Session will commence on the 2nd October, 1876.

Evening Classes.—Professor A. Freire-Marreco, M.A. Twelve Lectures on the Principles of Modern Chemistry, and its relation to other Molecular Forces. Mondays, at 7.45, commencing October 29, 1877.

OWENS COLLEGE, MANCHESTER.

Professor and Director of the Chemical and Metallurgical Laboratories.—H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Professor of Organic Chemistry.—C. Schorlemmer, F.R.S.

Demonstrators and Assistant Lecturers.—Mr. W. C. Williams, F.C.S., Mr. M. M. Pattison Muir, F.R.S.E., and Mr. Thomas Carnelley, D.Sc.

Hon. Demonstrator in Metallurgical Laboratory.—Mr. James Taylor.

Lecture Courses.

Systematic Chemistry.—Junior Class.—Tuesday, Thursday, and Saturday, from 9.30 to 10.30 a.m., during Michaelmas and Lent Terms. Comprising—(1) The laws of Chemical Combination; (2) a description of the physical and chemical properties and the mode of preparation of the Non-Metallic Elements and of their Compounds.

Senior Class.—Monday, Wednesday, and Friday, from 9.30 to 10.30 a.m., during the Michaelmas and Lent Terms, comprising—(1) The Chemistry of the Metals and of their most important Compounds; (2) Organic Chemistry.

The instruction in Systematic Chemistry is given by means (*a*) of Experimental Lectures and (*b*) of Tutorial Classes.

Fee—For each Class, £2 12s. 6d.; for both Classes, £3 14s. 6d.

A Tutorial Class, meeting in Sections, will also be held; which all members of the Junior and Senior Classes will be required to attend, unless specially exempted by the Principal and the Professor. Extra fee for this Class, 10s. 6d. This fee is not included in the composition fees payable by regular Students.

Organic Chemistry.—Professor C. Schorlemmer, F.R.S. Tuesday, Thursday, and Friday, from 2.30 to 3.30 p.m.

The subject of this Course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general Course in Systematic Chemistry.

Fee, £3 10s.

Technological Chemistry.—Monday and Wednesday, from 2.30 to 3.30 p.m.

The chemical principles involved in the most important Chemical Manufactures will chiefly be considered in this Course. The subject will be discussed as follows:—

1. Twenty Lectures on Water, Air, and the Chemistry of Fuel and the Gas Manufacture, by Mr. Muir.

2. Twenty Lectures on the Chemistry of Colouring-Matter, Dyeing, and Calico-Printing, by Professor Schorlemmer.

Students attending this Class must be acquainted with the principles of chemical science.

Fee, £1 11s. 6d.

Chemical Philosophy.—Prof. C. Schorlemmer, F.R.S. Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Laws and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

Analytical Chemistry.—Mr. W. C. Williams, F.C.S. Thursday, from 10.30 to 11.30 a.m.

This Course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY COURSES.

The Chemical Laboratories will be open for Students daily from 9.30 a.m. until 4.30 p.m., except on Saturdays, when they will be closed at 12.30 p.m.

Fees for the Session—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s. Students entering the Laboratory Class at or after Christmas will be charged two-thirds of the fees for the whole Session.

Fees for shorter periods—For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s. Students entering under this scale are entitled to work on every day during the week.

Entrance Exhibitions.

I. Victoria Exhibition (Classics), £15.

II. Wellington Exhibition (Greek Testament), £15.

III. Dalton Mathematical Exhibition, £15.

The Victoria and Dalton Exhibitions are renewable for a second year.

IV. Grammar School Scholarships, £15 per annum, tenable for three years; open to scholars of the Manchester Grammar School only.

V. Two Oxford and Two Cambridge Local Exhibitions, giving free admission to lecture classes in the College for one year, and renewable for two years further; awarded on the results of the Oxford and Cambridge Examinations held in Manchester respectively in June and December, 1877.

VI. Gilchrist Scholarship, £50 per annum, tenable for three years; awarded on the results of the Matriculation Examination of the University of London, in June, 1878.

VII. Baumann Scholarships, £45 per annum, tenable for three years. The next competition will take place in 1878.

VIII. Ramsbottom Scholarship, £40 per annum, tenable for two years. The next competition will take place in 1879.

IX. Four Whitworth Exhibitions, giving free admission to certain Day Lecture Classes, which will enable the holders to prepare themselves for the competition for the Scholarships of £100 per annum founded by Sir Joseph Whitworth, Bart.

Scholarships and Prizes.

The following (except the Shakspere Scholarship) are open to the competition of students of the College only. The regulations prescribing the terms of competition and tenure will be found in the "Calendar."

I. Victoria Scholarship (Classics), £40 per annum, tenable for two years.

II. Wellington Scholarship (Greek Testament), £20 per annum, tenable for two years.

III. Shuttleworth (Political Economy), £50, tenable for one year.

IV. Shakspere Scholarship (English Language and Literature), £40 per annum, tenable for two years.

V. Dalton Chemical Scholarships, two, each of £50 per annum, tenable for two years.

VI. Dalton Mathematical Scholarships, one Senior and one Junior Scholarship, of the value of £25 each, tenable for one year.

VII. Heginbottom Physical Scholarship, £20 per annum, tenable for two years.

VIII. Ashbury Scholarships (Engineering), two, each of £25 per annum, tenable for two years.

IX. Platt Scholarships (Physiology), two, each of £50 per annum, tenable for two years.

X. Crace-Calvert Scholarship (Chemistry), £25, tenable for two years; open to Evening Students in Chemistry only.

XI. Dalton Natural History Prize, value £15.

XII. Shuttleworth History Prize, value £5.

XIII. Classical Essay Prize, value £5.

XIV. Junior Classical Prizes, value £5 and £2 10s.

XV. Lee Greek Testament Prizes, one of £25 and one of £12 10s. value.

XVI. English Essay and Poem Prizes, each of the value of £5.

XVII. Engineering Essay Prize, value £5.

XVIII. Early English Text Society's Prizes.—A selection of the Society's publications offered to the competition of students in the Day and in the Evening Classes respectively.

XIX. Cobden Club Book Prizes (Political Economy).

XX. Bryce Law Prize, value £10.

XXI. New Shakspere Society's Book Prizes.

ROYAL COLLEGE OF SCIENCE FOR IRELAND

STEPHEN'S GREEN, DUBLIN.

Professor of Practical and Theoretical Chemistry.—R. Galloway, F.C.S.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week-day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical Research. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with Free Education, including Laboratory Instruction, tenable for three years; three become vacant each year.

A Diploma of Associate of the College is granted at the end of the three years' course.

The Session commences on Monday, October 1st.

ANDERSON'S COLLEGE, GLASGOW.

Chemical Department.—Professor W. Dittmar, F.R.S.E.

WINTER SESSION, 1877-78.

I. Lectures on Chemistry; daily, Saturdays excepted, from 10 to 11 a.m., commencing on November 1. A Course of about 100 Experimental Lectures, comprising Inorganic Chemistry, the more important chapters of Organic Chemistry, and the elements of Chemical Philosophy. Fee, £2 2s., except to students wishing to graduate in Edinburgh University, who must pay the Glasgow University Fee of £3 3s.

II. The Laboratory, for practical instruction in analysis, technical assaying, and the preparation of chemicals, and for original investigation, is open daily, Saturdays excepted, from 10 to 5, commencing on October 15.

Fees for the Session—To students working full time, £10 10s.; to students attending twice a week, each time for two stated consecutive hours, £5 5s., inclusive of the use of instruments, of the more expensive apparatus, and of the laboratory sets of reagents.

III. Evening Class for Practical Chemistry. Mondays, from 7.30 to 9.30 p.m., commencing on October 15. Fee for the Session, £3 3s., inclusive of all apparatus and chemicals.

IV. Popular Evening Lectures on Organic Chemistry. (The "Freeland Lectures.") Fridays, from 8.30 to 9.30, commencing October 5.

During the Summer Session, which commences early in May and terminates at the end of July, the Laboratory will be open daily from 9 to 5, Saturdays excepted. Fee to students working full time £6 6s.; attending twice a week, each time for two stated consecutive hours, £3 3s.

The Practical Class for Medical Students will meet thrice a week, for two hours each time.

THE "YOUNG" CHAIR OF TECHNICAL CHEMISTRY, ANDERSON'S COLLEGE.

Professor.—Edmund J. Mills, D.Sc. (Lond.), F.R.S.
Senior Assistant.—Mr. J. B. Hannay, F.R.S.E.
Junior Assistant.—Mr. T. J. Allan.

This Chair has for its object the instruction of Students in Chemistry as applied to the various branches of industry in Chemical and other works, Metallurgy, Agriculture, &c.

LECTURES.—*Principal Course.*—A Course of Fifty Lectures will be delivered on Mondays, Tuesdays, and Wednesdays, at 9 a.m., commencing on November 6th. The Lectures will be illustrated with Experiments, Diagrams, and Models, as well as by the actual Inspection of Manufacturing Processes; and the progress of the Students will be tested by periodical Examinations. The earlier Lectures will have reference to units of weight and measure, to the calculations necessitated by Chemical operations, and to the nature and laws both of the Chemical process and its results. A particular subject will then be considered in comparatively minute detail.

Fee for the Course, Two Guineas. Admission free to Laboratory Students.

Subsidiary Course.—A Course of Thirty Lectures will be delivered on Mondays, Tuesdays, and Wednesdays, at 9 a.m., commencing on May 1st. These Lectures are more particularly intended for Dyers, Colour Manufacturers, Brewers and Distillers, Tar Rectifiers, Drysalters, and others interested in a knowledge of Technical *Organic* Chemistry.

Fee for the Course, Two Guineas.

Laboratories.—The Laboratories are open daily from 10 to 4, and on Saturday from 10 to 1 o'clock for practical working by the Students, under the superintendence of the Professor and his Assistants.

The Fee for attending the Laboratories is £18 per Session of Nine Months, £13 for Six Months, £7 for Three Months, or £2 10s. per Month. Students are supplied with a working table containing the ordinary reagents required for analysis, and such apparatus as retort-stands, gas jets, &c. Small articles—such as Berlin porcelain, evaporating basins, funnels, retorts, flasks, beakers, &c.—Students are required to provide for themselves. Larger and more expensive apparatus—such as large evaporating basins, retorts, flasks, bottles, funnels, thermometers, &c.—are lent for experiments. Students must have a fair acquaintance with elementary Chemistry.

Memorandum as to Bursaries.

The Trustees of the "Young" Chair have the superintendence of the Bursaries—regulating the appointment and terms on which they shall be held.

The Nominees of Donors to be appointed if they pass the necessary examinations.

The Bursaries are of the amount of £50 each per annum, tenable for three years, during which the Bursars shall be required to give their whole time and attention to the Lectures and Laboratory duties of the "Young" Chair, paying the ordinary fees. Candidates to have attained sixteen years of age on application, to be of good moral character, and to pass such examinations as may be prescribed by the Trustees in the ordinary branches of an English education and the elementary principles of Chemistry. The Bursaries to be liable to forfeiture on the Bursars failing to exhibit approved progress under the Professor of the Chair, or being guilty of conduct, in the opinion of the Trustees, unworthy of their position. The Bursaries are only given to those whose means are limited, and who intend following some branch of Manufacturing Chemistry.

CHEMICAL LECTURES, CLASSES, AND LABORATORY INSTRUCTION.

BERNERS COLLEGE OF CHEMISTRY AND THE EXPERIMENTAL SCIENCES, 44, Berners Street, W.—Prof. E. V. Gardner, F.A.S., M.S.A. The Laboratory is open morning and evening throughout the year.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.—Mr. Henry C. Jones, F.C.S. A course of thirty Elementary Lectures on Organic Chemistry, on Tuesday Evenings. Begin Oct. 2.

NEW CENTRAL SCHOOL OF CHEMISTRY AND PHARMACY, 173, Marylebone Road, London.—Chemistry and Physics, Mr. A. P. Luff, F.C.S., Pereira Medallist, &c.; Pharmacy, Botany, Materia Medica, &c., Mr. J. Woodland, M.P.S.

ROYAL POLYTECHNIC COLLEGE.—The Annual Course consists of three terms, each averaging ten Experimental Lectures. 7.30 p.m. Fee 6s. per term, Session 15s. Practical Chemistry; fee, 12s. per term.

ROYAL VETERINARY COLLEGE, Camden Town.—Professor of Chemistry, Mr. R. V. Tuson.

WORKING MEN'S COLLEGE, 91, Blackfriars' Road.—Teacher of Chemistry, Mr. J. D. Allen.

SCHOOL OF PHARMACY OF THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 17, Bloomsbury Square.—The school opens on Monday, the 1st of October. Lectures on Chemistry and Pharmacy, by Professor Redwood, on Monday, Tuesday, and Wednesday mornings, at 9 a.m. The Laboratories for Practical Instruction in Chemistry as applied to Pharmacy, &c., under the direction of Prof. Attfield, will be open daily at 10 a.m. throughout the Session. The object of the founders of the Pharmaceutical Society of Great Britain in promoting a School of Pharmacy was to provide sound instruction, not in the practice of Pharmacy, but in the principles on which the

practice of Pharmacy should be based. They therefore, in the year 1842, instituted lectures on Chemistry, Chemical Physics, Pharmacy, Botany, and Materia Medica; and in 1844 added a Laboratory for instruction in Practical Chemistry. Such a curriculum provides a sound course of instruction in the respective subjects, and such, the Professors would add, is the only kind of scholastic or collegiate course of instruction which the Pharmaceutical Society or the Provincial Pharmaceutical Associations have instituted. In the shop or dispensary only should "Prescriptions" and "Practical Dispensing" be studied. These subjects should find no place in a true school of pharmacy, which, in teaching the principles on which the practice of pharmacy is based, seeks only to supplement and strengthen, not supplant, the practical teaching of the shop. The Professors strongly advise all learners, both before and during attendance at the school, to avoid studying merely by way of "preparation for examination." For "examination" even by the most highly skilled "Board," with ample time at its disposal and a wide area from which to select questions, is admitted by all authorities on education, whether statesmen, teachers, or examiners, to be but a partial test of knowledge and an extremely imperfect test of education. The student who only seeks the kind of information which will enable him to pass an examination mistakes the means for the end. So far from examination being the end and knowledge the means by which that end is accomplished, knowledge should be the end in view, and examination be regarded as a rough and partial test of the extent to which knowledge has been obtained. Not alone the knowledge which can be tested by examination, but that which cannot be so gauged, should, in all honour and in the highest self-interest, be the knowledge ever assiduously sought. The desire should not be for knowledge which, wanted only for the temporary purpose of examination, is rapidly gained and as rapidly lost, but for knowledge which will last. In short, the one desire should be *education*, that is knowledge accompanied by enlightenment of the understanding, mental training, mental discipline, and general elevation of the intellect. As for "examination," students of the School may rest assured that if they, guided by the Professors, work diligently, thoughtfully, deliberately, and thoroughly, they will with ease and pleasure pass any examination in the subjects in which they have thus been truly educated.

Council Prizes.—At the end of each of the five months' Courses of Lectures on Chemistry and Pharmacy, and Botany and Materia Medica, a Bronze Medal and Certificates of Merit, and at the close of the Session (ten months) a Silver Medal and Certificates of Honour and Merit, are offered for competition by the Council. In the Class of Practical Chemistry, the Silver Medal, two Bronze Medals, and Certificates of Honour and Merit, offered by the Council, are competed for at the end of the Session only.

SOUTH LONDON SCHOOL OF CHEMISTRY, 325, Kennington Road.—Dr. John Muter, F.C.S. Daily, at 10 a.m. Sixty Lectures on Theoretical Chemistry, and Junior and Senior Course of Practical Chemistry.

BIRMINGHAM.—MIDLAND INSTITUTE.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.; Friday, at 7; and Saturday, at 3.

BIRMINGHAM.—QUEEN'S COLLEGE.—A. C. Bruce, M.A.

BRISTOL MEDICAL SCHOOL.—Mr. T. Coomber, F.C.S.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.—J. Campbell Brown, D.Sc. Lond., F.C.S.

SCHOOL OF TECHNICAL CHEMISTRY, 7 and 9, Hackin's Hey, Liverpool.—Mr. A. Norman Tate.

COLLEGE OF CHEMISTRY, LIVERPOOL—Mr. S. H. Johnson, F.C.S.

LEEDS MECHANICS' INSTITUTION.—Mr. G. Ward, F.C.S.

MANCHESTER GRAMMAR SCHOOL.—Mr. Francis Jones, F.C.S., F.R.S.E.

MANCHESTER MECHANICS' INSTITUTION.—Mr. M. A. Watts, M.A.

CHEMICAL LECTURES AT LONDON HOSPITALS.

Chemical Schools and Colleges.	Winter Session.				Summer Session.			
	Lecturers on Chemistry.	Days and Hours.	Fees. One Course.	Fees. Perpetual.	Lecturers on Chemistry.	Days and Hours.	Fees. One Course.	Fees. Perpetual.
			£ s.	£ s.			£ s.	£ s.
St. Bartholomew's Hosp. and College	Dr. Russell, F.R.S.	M. W. F., 9	5 5	7 7	Dr. Russell	M. Tu. F., 11 [to 1	2 2	3 3
Charing Cross Hospital and College	Mr. Heaton	M. W. F., 11	5 5	7 7	Mr. Heaton	M. F.	1 1	2 2
St. George's Hospital	Mr. Wanklyn	Tu. Th. S., 11	6 6	8 8	Mr. Wanklyn	Tu. Th. 10	2 2	4 4
Guy's Hospital	Dr. Debus, F.R.S., and Dr. Stevenson	Tu. Th. S., 11	5 5		Dr. Debus	M. W. F., 10 [to 1	4 4	
King's College and Hosp.	Mr. Bloxam, F.C.S., Mr. Hartley, and Mr. Thomson	Th. S., 10	7 7	10 10	Mr. Bloxam and Mr. Hartley, & Mr. Thomson	M. W. F., 10	5 5	8 8
London Hospital	Dr. Tidy	M. Tu. W. Th., 11	7 7	7 7	Dr. Tidy	M. Th. S., 9	2 2	
St. Mary's Hospital	Dr. Wright	M. W. Th., 4	4 4	6 6	Dr. Wright	Tu. F. S.	3 3	
Middlesex Hospital	Mr. W. Foster	M. W. Th. F., 9	6 6	8 8	Mr. W. Foster	M. W. F., 3	3 3	
St. Thomas's Hosp. & Schl.	Dr. Bernays	Tu. Th. F., 10			Dr. Bernays	M. Th. F., 10		
University Col. & Hosp.	Dr. Williamson, F.R.S., and Dr. Graham	Daily (ex. S.), 11	7 7	9 9	Dr. Williamson & Dr. Graham	Daily (ex. S.), 11	4 4	7 7
Westminster Hospital	Dr. Dupré, F.R.S.	W. Th. F., 3	5 5		Dr. A. Dupré	M. W. F., 10	3 3	

QUEENWOOD COLLEGE, near Stockbridge, Hants.—Mr E. W. Prevost, Ph.D., F.C.S., F.R.S.E.

SHEFFIELD BOROUGH ANALYSTS' LABORATORY, 1 and 3, Surrey Street.—Mr. A. H. Allen, F.C.S. Day and Evening Classes.

SHEFFIELD SCHOOL OF MEDICINE.—Mr. A. H. Allen, F.C.S. A course of forty-five Lectures on Inorganic and Organic Chemistry is delivered by Mr. Alfred H. Allen during the Winter session. The Summer Course of Practical Chemistry is under the direction of Mr. A. H. Allen.

UNIVERSITY OF ABERDEEN.—Prof. J. S. Brazier.

ABERDEEN SCHOOL OF SCIENCE AND ART MECHANICS' INSTITUTION.—Mr. Thomas Jamieson, F.C.S.

DUNDEE LITERARY INSTITUTION CHEMICAL LABORATORY.—Classes in Practical Sciences (Inorganic Chemistry and Physics).—Dr. Frank W. Young, F.C.S.

CHEMICAL LABORATORY.—Prof. ... Crum Brown, F.R.S.E.

SCHOOL OF MEDICINE, EDINBURGH.—Dr. Stevenson Macadam, F.R.S.E., Mr. Falconer King, and Mr. Ivison Macadam.

GLASGOW UNIVERSITY.—Prof. J. Ferguson.

GLASGOW MECHANICS' INSTITUTION.—Mr. R. R. Tatlock, F.R.S.E., F.C.S.

GLASGOW VETERINARY COLLEGE.—Mr. Stephen Cooke, F.C.S.

SCHOOL OF CHEMISTRY, 138, Bath Street, Glasgow.—Dr. Wallace, Mr. Tatlock, and Dr. Clark. Day and Evening Classes.

CHEMICAL LABORATORY, 144, West Regent Street, Glasgow.—Dr. Milne. Day and Evening Classes.

ANALYTICAL LABORATORY, 88, Hope Street, Glasgow.—Dr. A. T. Machattie, F.C.S. Day and Evening Classes.

QUEEN'S COLLEGE, BELFAST.—Dr. Andrews, F.R.S., &c.

QUEEN'S COLLEGE, CORK.—Dr. Maxwell Simpson.

QUEEN'S COLLEGE, GALWAY.—Dr. T. H. Rowney.

ROYAL COLLEGE OF SURGEONS IN IRELAND.—Dr. C. A. Cameron.

DUBLIN, CARMICHAEL SCHOOL.—Dr. C. R. C. Tichborne.

DUBLIN, CATHOLIC UNIVERSITY.—Mr. Campbell.

DUBLIN, DR. STEEVENS'S HOSPITAL AND MEDICAL COLLEGE.—Mr. McHugh.

ON THE COMPOSITION OF FERRIC PHOSPHATE.

By G. W. WAINE

IT appears to be generally believed that the precipitate formed by the reaction between ferric chloride and ordinary phosphate of sodium varies in composition accordingly as either salt is in excess. To ascertain if this be true, I prepared some pure crystallised ferric chloride (Fe_2Cl_6). I found some difficulty in obtaining this free from ferrous chloride, which is always present in the product of the action of chlorine upon heated iron wire, even though the former is employed in large excess. The chlorination could be completed only by keeping the crystals of ferric chloride in a bottle of chlorine gas freely exposed to light.

Standard solutions of this and hydro-disodic phosphate (Na_2HPO_4) having been prepared, two samples of the ferric phosphate were made:—

A. By adding the ferric chloride to sodium phosphate *in excess* with constant stirring.

B. By adding sodium phosphate to ferric chloride.

It was found that the precipitates could not be washed by decantation, for they would not subside properly, and easily passed through the pores of a filter; so they were transferred to dialysers of parchment-paper, which were suspended over large volumes of distilled water, renewed in a day or two, when it contained much salt. This was found to be a perfect method of washing the gelatinous precipitates, and it is probably to the want of such a method at an earlier date that we must ascribe the discrepancies in the results of different analyses of the ferric phosphate.

When completely washed, the precipitates were dried and ignited. The process first adopted for determining their composition consisted in dissolving them in hydrochloric acid, and determining the iron by means of a standard solution of potassium permanganate, after reduction to the ferrous state by means of sodium sulphite. Five determinations made in this way gave as a mean result:—

For A (prepared by adding Fe_2Cl_6 to Na_2HPO_4), 38·01 per cent iron.

For B (prepared by adding Na_2HPO_4 to Fe_2Cl_6), 38·63 per cent iron.

This would give, for one molecule of PO_4 (= 95) in A 1·04 as the atomic proportion of Fe (= 56); in B, 1·06. Whence it appears that the precipitate is essentially $FePO_4$, but that it has a tendency to contain a slight excess of iron, especially when precipitated in the presence of an excess of ferric chloride.

In the course of these analyses I noticed that the number of divisions of the permanganate solution required in successive determinations did not agree so closely as is usual in the volumetric estimation of iron, evidently in consequence of a difficulty in ensuring the complete reduction of the ferric phosphate to the ferrous state.

Some more analyses were then made, in which the phosphoric acid was estimated by adding to the hydrochloric solution some citric acid, then ammonia in excess and ammonium sulphide, boiling, filtering, and precipitating the phosphoric acid as magnesium-ammonium-phosphate.

Two analyses of each sample gave, for one atom (56) of iron:—

A.	B.
I. 1·004 mol. PO_4	I. 0·91 mol. PO_4
II. 0·97 ,,	II. 0·95

When the precipitated ferric phosphate was exposed to air dried by sulphuric acid until its weight was constant, it was found to contain 2·65 molecules of water for each atom of iron present; this water was not entirely expelled at 250° C. The precipitate appears, therefore, to be represented by the formula $2FePO_4{,}5H_2O$.

I have endeavoured to determine phosphoric acid volumetrically by mixing the solution with potassium iodide and starch, and adding a standard solution of ferric chloride until an excess was indicated by the liberation of iodine; but I found that the mixture of potassium iodide and starch was far less sensitive to the action of ferric chloride than to that of chlorine, so that it was possible for iodide of potassium and ferric chloride to coexist in the solution for some minutes. In attempting to use potassium sulphocyanide to indicate the excess of ferric chloride, I found that the delicacy of the reaction was seriously impaired when acetic acid was present, a condition which would of necessity exist in most determinations of phosphoric acid for practical purposes.

SCHEELE'S GREEN.

By S. P. SHARPLES, S.B.

A CURIOUS error in regard to this salt has found its way into many of the text-books. Watts, in his Dictionary, states that it is dissolved by an excess of ammonia without colour. In this he is supported by Graham Otto (last edition) and the Handwörterbuch.

This evidently arises from a misunderstanding of Berzelius's* description of this substance. After describing the preparation of arsenite of copper by means of arsenious acid and the carbonate of copper, he goes on to say:—

A neutral combination is obtained, when sulphate of copper is precipitated by means of arsenite of potassium. The precipitate is green. When the alkali is in excess, the colour is brightened; but it decomposes spontaneously after a time and becomes dark-brown, and contains cupric arsenate and cupreous arsenite. This salt is dissolved by ammonia to a colourless liquid, which most likely contains cupreous arsenate.

"*This salt*" in the above sentence evidently refers not

* Wöhler's Trans., 1838.

to the green salt, but to the brown. That this view is correct is confirmed by numerous experiments I have made upon the subject, and by the following description, which is found in Rosé's "Qualitative Chemistry," Paris, 1859, p. 384. Speaking of Scheele's green, the author says:—"This precipitate is soluble in an excess of ammonia, and also in an excess of hydrate of potassa; the solution in both cases is of almost the same blue colour. The blue solution formed by the potash deposits after a time reddish-brown suboxide of copper. The liquid becomes colourless, and contains potassium arsenate. The blue solution formed by ammonia is not modified by time." To this I will add that ammonia does not decompose Scheele's green by prolonged boiling; the copper may, however, be completely precipitated as suboxide by the addition of potassa to the ammoniacal solution.—*American Chemist.*

ON A NEW METHOD OF DETERMINING PHOSPHORUS, ARSENIC, SULPHUR, CHLORINE, BROMINE, AND IODINE IN ORGANIC SUBSTANCES.

By M. G. BRUGELMANN.

The method proposed by the author consists in burning the organic matter in a current of oxygen and in condensing the products by an incandescent layer of pure lime, or of soda lime, in the case of the determination of bromine and iodine. We operate in a tube of Bohemian glass open at both ends, of an internal diameter of 12 m.m. Here are introduced successively—First, a leaf of platinum of the width of 2 centimetres, rolled in a spiral, and forming a plug. Second, a layer of lime in granules, or soda lime, which is heaped lightly so that it may occupy all the diameter of the tube; a length of 10 centimetres is given to this layer, which is quite sufficient to retain completely the elements to be determined. Third, a second leaf of platinum of a width of 5 centimetres rolled into a spiral; when the body in question contains phosphorus or arsenic, this spiral should be replaced by a layer of fragments of very small infusible glass. Fourth, a layer of asbestos of a length of 15 centimetres; this layer is indispensable to prevent explosions when we are operating upon volatile bodies or on substances emitting at a temperature slightly elevated combustible gases or vapours. Fifth, the substance introduced directly into the tube, or contained in a small boat or vial may be in large pieces. Finally, the tube is closed by a stopper holding a very narrow tube (diameter 0·5 m.m.), through which the oxygen is transmitted; the extremity of the tube remains open. The total length of the tube is from 40 to 50 centimetres. We commence by heating the first half of the layer of lime, then oxygen is caused to enter, whilst the other half is raised to redness; at this moment we commence the combustion of the substance. The oxygen ought always to be in excess in the tube, so that the products arriving on the lime are entirely burnt; in any case the lime should not blacken. The speed of the current of oxygen is liable to variations, but on the average 100 c.c. may enter per minute.

If we burn volatile matters or substances which are decomposed at a low temperature, giving off vapours, we cannot always prevent explosions, even on heating with great precaution; in this case we commence the combustion in a current of air, and only turn on oxygen at the moment when we have driven by heat all the substance into the layer of asbestos. Substances rich in phosphorus are mixed with three times their weight of lime and placed in a large platinum boat. When the combustion is finished we break the tube at the place where the layer of asbestos touches the platinum spiral, we remove with care the smallest particles of asbestos, we clean the outside of the tube, and we heat the contents with water to clean it completely; then we add gradually nitric acid until the whole is in solution; in this way we only employ a slight excess of nitric acid. It is well understood that the tube and boat ought to be rinsed carefully in weak nitric acid. In this solution the haloid elements are precipitated in the state of chloride, bromide, or iodide of silver, where they are determined volumetrically by Volhard's process by means of two standard solutions of sulphocyanide of ammonium and nitrate of silver, ferric sulphate serving as an indicator. Let us add, however, that a part of the iodine is found in the state of free iodine and of iodic acid, and ought to be brought back previously to the state of hydriodic acid by the addition of sulphurous acid until the liquid is decolourised.

Sulphuric acid is determined as sulphate of barium, or else volumetrically by a standard solution of chloride of barium, after the method of Wildenstein, which the author has modified slightly. Finally, the phosphoric or arsenic acids are volumetrically determined with nitrate of uranium. The lime and soda-lime are employed in the form of grains whose diameter exceeds 1 millimetre; they ought to be free from chlorine, sulphur, phosphorus, iron, and aluminum. The author describes the preparation of pure lime and soda-lime; for this latter he employs 4 parts of pure lime and 1 part of pure soda prepared from sodium.

The method seems to us to present a great interest for determining chlorine, sulphur, or phosphorus in substances which are poor in these elements, such as vegetable and animal products; it enables us, in fact, to burn in a short time a large quantity of matter (about 20 grms. in two hours).—*Zeitschrift für Analytische Chemie*, xv., and xvi., 1.

SCHŒNBEIN'S TEST FOR NITRATES.

By F. H. STORER,

[illegible]

The defect of the usual method of testing for nitrates having been made apparent, I have naturally endeavoured to discover some better method of procedure which, while preserving all the delicacy of the test, should permit its general application. Casting about for some means of reducing nitrates to nitrites which should not at the same time occasion the formation of peroxide of hydrogen, I have finally hit upon the simple device of boiling the nitrate with metallic cadmium in water that is slightly acidulated, instead of operating with neutral solutions, as has hitherto been recommended. Contrary to what might have been inferred from what has been published hitherto, and from what is known of the action of acidulated water upon metals in the cold, no peroxide of hydrogen is formed when water slightly acidulated with sulphuric acid is boiled upon metallic cadmium; and since the reduction of nitrates to nitrites by means of cadmium occurs readily in such boiling acidulated solutions it happens that the iodo-starch test can be employed in this way for the detection of nitrates without difficulty and with a high degree of certainty. The only special precautions to be taken are to test the boiled liquid with litmus paper in order to be sure of its acidity, and to guard against the loss of any nitrous acid by volatilisation. This can readily be done by attaching to the small flask in which the nitrate is reduced a small inverted Liebig's condenser, through the sleeve of which a stream of cold water is made to flow. The following experiments will illustrate the delicacy of this new method of testing:

A. 0·0005 grm. N_2O_5, in the form of nitrate of potash, was boiled for five minutes upon metallic cadmium in 50 c.c. of pure water to which two drops of the dilute sulphuric acid (see note on p. 117) had been added. On testing

with iodo-zinc-starch plus acid a strong reaction was ob ta ned, almost immediately.

B. 0·0002 grm. N_2O_5 similarly treated gave a reaction in about five minutes.

C. 0·0001 grm. N_2O_5 gave a reaction in rather less than fif een minutes.

D. 50 c.c. of pure water acidulated with two drops of the dilute sulphuric acid, and boiled upon cadmium, without any addition of a nitrate, gave no reaction with iodo-zinc-starch plus acid, not even on standing over night.

Repetitions of these trials gave results that were identical with the foregoing.

E. 0·00005 grm. N_2O_5 in 50 c.c. of pure water was tested, as above, in comparison with pure water devoid of nitrate. At the end of half an hour the solution that had contained the nitrate gave a rather strong colouration with the iodo-starch, while the pure water remained perfectly colourless.

F. 0·00001 grm. N_2O_5 in 50 c.c. water was tested as above. But no reaction was obtained with the iodo-starch, not even after the lapse of 36 hours.

G. In order to determine whether metallic cadmium in acidulated water actually destroys peroxide of hydrogen at the temperature of boiling, 100 c.c. of pure water were boiled upon cadmium and left to stand in contact with the metal over night; the water thus charged with peroxide was divided into two equal portions, one of which was tested directly with iodo-starch plus acid, while the other was acidulated with two drops of dilute sulphuric acid, again boiled upon cadmium, and then tested. A strong reaction was obtained in the portion tested directly, but no reaction was obtained from the acidulated portion until after the lapse of two hours, and then the colouration was but slight. In repeating this experiment, 100 c.c. of pure water were boiled upon cadmium for five minutes; 50 c.c. of the water were then poured off to be tested, while two drops of dilute sulphuric acid were added to the flask, and the acidulated liquid was again boiled for five minutes with the cadmium. On decanting and testing the acidulated liquid with iodo-starch, it gave no colouration, not even after the mixture had stood over night, while on testing the portion that had been boiled without acid it gave a strong colouration in due course.

H. To see if hydrogen alone would so quickly destroy the peroxide, a stream of hydrogen gas was made to flow during five minutes through a solution of peroxide of hydrogen, prepared as above, that was kept at a temperature of boiling. But the liquid thus treated gave almost as strong a reaction with iodo-starch after the passage of the hydrogen as it had done before.

On trying whether some one of the more common metals might not perhaps be used in testing for nitrates by the new method, it appeared that neither of them is on the whole so well fitted for the purpose as cadmium. Thus on repeating the foregoing experiments, with zinc, amalgamated zinc, aluminum, and iron, it appeared that while no peroxide of hydrogen was formed on boiling acidulated water upon these metals, neither of them was so well fitted as cadmium to reduce nitrates to nitrites in acidulated solutions. From zinc and from amalgamated zinc, distinct reactions were obtained with solutions containing 0·0005 grm. N_2O_5 in 50 c.c. water, when the iodo-starch mixture was left to stand over night, though no colouration appeared until after the lapse of more than two hours; slight reactions were obtained also, after long standing, from solutions that contained 0·0001 grm. N_2O_5; but no reaction was obtained in a solution that contained 0·00005 grm. N_2O_5. From aluminum a slight colouration of the iodo-starch was obtained, after two hours standing, with a solution that contained 0·01 grm. N_2O_5 in 100 c.c. water, and a stronger reaction was got from a solution that contained more of the nitrate. From iron no reaction was obtained in the course of two hours with a solution containing 0·01 grm. N_2O_5 in 100 c.c. water, though with a considerably stronger solution a reaction was obtained. A solution containing 0·01 grm. N_2O_5 in 100 c.c. water boiled upon a mixture of iron and platinum gave a reaction almost immediately, but one containing 0·001 grm. N_2O_5 gave no reaction after having been boiled upon the mixed iron and platinum. No reaction was obtained with a solution containing 0·01 grm. N_2O_5 in 100 c.c. water after adding to it a small quantity of acidulated sulphate of silver and boiling the mixture upon iron.

Both lead and magnesium easily reduce nitrates to nitrites in acidulated solutions, magnesium perhaps even more readily than cadmium, but neither of them would seem to be so good as cadmium for use in testing for nitrates, since they form peroxide of hydrogen when boiled in water that is no more strongly acidulated than that just described. The trouble with both metals, but particularly with magnesium, seems to be that they combine with and consume the acid too rapidly, so that the solution becomes neutral or well nigh neutral, and fit for the production of peroxide of hydrogen, before the boiling process is finished.

In experiments with lead it was found that a solution containing 0·0001 grm. N_2O_5 in 50 c.c. gave a decided reaction with iodo-starch in less than half an hour, and that a solution containing 0·00005 grm. N_2O_5 gave a distinct reaction in half an hour, though it was not quite as strong as the reaction obtained with cadmium under similar circumstances. 50 c.c. pure water plus two drops dilute sulphuric acid, boiled five minutes upon lead without the addition of any nitrate gave a slight reaction with iodo-starch and acid on standing over night; but on repeating the experiment with four drops of acid no reaction was obtained.

In experiments with magnesium it was found that nitrate solutions containing respectively 0·0001 and 0·00005 grm. N_2O_5 in 50 c.c. water gave reactions with acidulated iodo-starch within fifteen minutes; and that a solution containing 0·00001 grm. N_2O_5 plus four drops of acid gave a distinct reaction on standing over night. But 50 c.c. pure water plus two drops dilute sulphuric acid boiled five minutes upon magnesium without addition of any nitrate gave a slight reaction in the course of two hours, and on repeating the experiment, with four drops of acid a slight reaction was obtained on leaving the mixture to stand over night, though none was visible at the end of two hours. With silver, an acidulated solution containing 0·025 grm. N_2O_5 in 50 c.c. water gave a very slight reaction with iodo-starch in the course of two hours, while a weaker neutral solution, containing 0·01 grm. N_2O_5 in 100 c.c. water that was boiled upon silver gave no reaction.

It is to be observed that in the foregoing set of experiments the solutions were acidulated in every instance before the boiling, and that an inverted condenser was always attached to the flask in order to prevent the escape of any nitrous acid.

Solutions containing 0·005 grm. N_2O_5 in 50 c.c. acidulated water, left in contact for eight hours or more in the cold with metallic aluminum, iron, or zinc, and then tested with iodo-starch gave no reaction in the cases of iron and zinc, and only a slight colouration in the case of aluminum.

No reaction for peroxide of hydrogen was obtained in acidulated water that had been boiled five minutes upon a mixture of pieces of tin and platinum, nor was any reaction obtained from an acidulated solution of nitrate of potash that had been similarly boiled.

Numerous trials were made to discover, if possible, some reducing agent which, though proper to change nitrates to nitrites in neutral solutions, should not form peroxide of hydrogen in such solutions; but all these efforts were unsuccessful. In point of fact there are comparatively few chemicals capable of reducing nitrates to nitrites in presence of much water; while most, if not all, of these substances readily form peroxide of hydrogen

when left in contact with water and air. Among metals* I have found only iron and lead that seem to be at all fit to be used as substitutes for cadmium or zinc, in testing for nitrates by the old method. Both these metals readily reduce nitrates to nitrites in dilute neutral solutions at the boiling temperature; but they, as well as magnesium, aluminum, and copper,† cause the formation of peroxide of hydrogen also, when boiled in pure water. Aluminum, though it reduces nitrates to nitrites in neutral solutions, seems to be inferior to zinc for this purpose, and magnesium, though it reduces nitrates very readily in neutral solutions, seems to form peroxide of hydrogen even more easily than cadmium.

The behaviour of iron and lead towards nitrates will appear from the following statement: Neutral solutions of nitrate of potash, containing 100 c.c. of water, 0·01 grm. (or more) of N_2O_5, gave a strong reaction with the iodo-starch, after having been boiled five minutes upon iron wire; with 0·001 grm. N_2O_5 the reaction soon appeared, and with 0·0001 grm. N_2O_5 the reaction appeared after some little time. A special experiment was made as follows to test the efficiency of iron as compared with that of cadmium or zinc: 50 c.c. of pure water were boiled for five minutes upon iron wire in one flask, while in another flask 50 c.c. of pure water, plus 0·0005 grm. N_2O_5, in the form of nitrate of potash, were boiled upon an equal amount of the iron wire. When cold, the liquids were transferred to porcelain capsules, mixed with iodo-zinc-starch and acid, and left to stand over night. Decided reactions were obtained in both instances, but the liquid to which the nitrate had been added was deeper coloured than the other, and the difference in tint between the contents of the two dishes seemed to be rather more marked than was the case in similar experiments where cadmium or zinc had been used instead of iron. It is not unlikely that iron would have been rather better fitted than either of these metals for use in testing for nitrates according to the old plan.

On repeating this last experiment with metallic lead, instead of iron, decided reactions were obtained with the iodo-starch in both dishes; but the colourations were of about the same depth as those ordinarily obtained with cadmium, and that obtained from the nitrate solution was no stronger than that from the pure water.

Solutions of nitrate of potash (0·01 grm. N_2O_5 to 100 c.c. water), made alkaline with potash or with lime, were reduced, with formation of nitrite, when boiled for five minutes upon iron, or left to stand over night in contact with the metal in the cold; but the reactions with iodo-starch that were obtained in this way were less strong than those got by operating upon neutral solutions of the nitrate.

The following substances failed to reduce nitrate of potash when boiled for five minutes with neutral solutions of that substance, containing 0·025 grm. N_2O_5 in 100 c.c. water, or, at the least, no reaction could be obtained with the iodo-starch after using them, viz.: filter-paper, phosphorus (ordinary and amorphous), arsenic, ferrous sulphate, ferrous sulphide, and sulphite of lead. No reaction was obtained when acidulated solutions of the nitrate, of the above-mentioned strength, were boiled with stannous chloride, ferrous sulphate, glucose, or arsenic. No reduction to nitrite was detected when solutions of the nitrate that had been mixed with lime were digested with ordinary or amorphous phosphorus, glucose, or ferrous sulphide, or when a solution that had been mixed with hydrate of potash was boiled upon metallic arsenic.

On the other hand, recently precipitated cupreous oxide, boiled for five minutes with neutral acid, and alkaline solutions of nitrate of potash (0·01 N_2O_5 in 100 c.c. water), reduced some of the nitrate in each instance, so that reactions were obtained on adding iodo-starch to the several filtrates, but as the reactions were not very strong there seemed to be little encouragement to proceed with the inquiry.

If it were less difficult than it is to manipulate with thoroughly boiled water so that no atmospheric air should come into contact with it, it would be possible, by using such water, to avoid the interference of peroxide of hydrogen in testing for nitrates in neutral solutions by Schœnbein's process; for, out of contact with the air, no peroxide of hydrogen is formed by the action of cadmium or zinc upon water that has been thoroughly boiled, in a glass flask provided with a long and very narrow outlet. Even when no special pains are taken to preserve such water from contact with the atmosphere after the boiling, it is easy to perceive that peroxide of hydrogen does not readily form in it. So, too, though in a lesser degree, with water that has been well nigh completely deprived of air by distillation in the vacuum of an air-pump. But no such inability to yield peroxide of hydrogen was observed in water that had been boiled for a long time in a copper flask, into the neck of which a long and very narrow brass tube had been soldered. The boiled water from the copper flask gave a reaction for the peroxide even when tested directly, without having been put in contact with any other metal.

I am much indebted to my assistant, Mr. D. S. Lewis, for his co-operation in this investigation.—*American Journal of Science and Arts.*

Bussey Institution, Jamaica Plain, Mass.

* I have, as yet, made no experiments with the alkali metals or their amalgams.

† And various other metals, as recorded in Gmelin Kraut's "Handbuch," i. (2 Abth.), p. 56.

Since the above statement, that iron forms peroxide of hydrogen on being boiled with water in contact with air, may seem to conflict with Schœnbein's observation that the peroxide is not formed when iron is shaken in water and air, it may be well to give the evidence on which it depends. Pure water was boiled with iron wire for five minutes; the cold liquid was mixed with iodo-zinc-starch solution and dilute sulphuric acid, and left to stand over night. A purplish colouration was obtained. On repeating the experiment, a precisely similar reaction was observed. This colouration is rather less, it should be said, than that obtained from the other metals enumerated above; but is, nevertheless, perfectly distinct and characteristic. In still another experiment, where pure water was boiled upon sheet iron, no reaction for peroxide of hydrogen was obtained. The liquid assumed a rusty tint, and no blue colouration could be perceived.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 95.)

Manufacture of Sulphuric Acid. By ROBERT HASENCLEVER, Manager of the Stolberg Works.

IF the Rhenania Chemical Works was willing to sell its two platinum vessels, one of which has been procured only a few years ago, while the other has been in use for twenty-one years, and has undergone repeated repairs at the price of 810 francs per kilo., the account would show a consumption of 0·972 grm. of platinum per 1000 kilos. of sulphuric acid, or an outlay on platinum equal to 1·616 franc, or 1·29 mark (not quite 1·3d.) per 1000 kilos. of acid at that strength.†

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† As regards the question what method of concentration is the more economical, the following information has been received by the editor from P. W. Hofmann, of Wocklum. At Dieuze, where 2500 kilos. of sulphuric acid are daily concentrated to 66° B. in glass vessels, the cost per 1000 kilos. is as follows:—

Coal, 200 kilos.	4 marks
Labour	3 „
Breakage	1 „

If the precaution is observed of changing all the retorts every six weeks, whether damaged or not, breakage can be almost entirely avoided, and the cost for glass reduced to about 75-100th of a mark.—A. W. H.

In general the acid at Hautmont and at Stolberg was free from nitrogen compounds; if nitrous acid was found on testing with indigo a little ammonium sulphate was added to the acid in the lead pans, according to the suggestion of Pelouze.

The two firms who exhibited platinum stills at Vienna were Desmoutis, Quenessen, and Co., of Paris, and Johnson and Matthey, of London. The apparatus differ in certain details. The English firm employ double syphons and cooling worms, whilst the French make use of a long single syphon. The capital which conducts away the weak acid slopes towards the boiler in the English apparatus, whilst in the Parisian it is bent away in the opposite direction. The English arrangement, by reason of its reflux yields less weak acid, but at the same time also a smaller quantity of concentrated acid than does the French.

The opinions of manufacturers concerning the stills of the two firms were upon the whole equally favourable. The English acid makers obtain their platinum stills for convenience sake generally from London, whilst many Continental manufacturers remain in connection with Desmoutis, Quenessen, and Co., on account of the rapidity of transport in case of repairs.

Both the stills exhibited in Vienna had a syphon of a new construction, one of whose legs, placed within the still, has a lateral aperture at the same level with the heating-flues. By means of this arrangement the acid in the apparatus can never fall below the level of the upper angle of the flue. The sheet platinum is therefore constantly covered by the liquid, whilst on the old principle the workman was not able to observe the level of the acid, and the syphon could run off the contents of the still to such an extent that the furnace-gases could play over and damage the dry metal.

The arrangement in the apparatus of Desmoutis, Quenessen, and Co. was proposed by the author.* In order to prevent the evacuation of the apparatus below the desired level, the lateral orifice in the syphon is connected with an air-pipe, which plunges in from above. It is thus contrived that the syphon always draws off sulphuric acid from the deepest part of the apparatus, whilst a simple lateral orifice in the syphon, without a tube opening upwards, would during regular working produce an influx of sulphuric acid into the syphon at this place. To prevent the acid spirting out during boiling a funnel with a movable cover is fitted to the top of the air-pipe. If it is wished to empty the apparatus entirely, the aperture of the funnel is closed with a plug, which is not kept by the workman in charge.

In the arrangement adopted by Johnson and Matthey for the same purpose a reciprocating cock is introduced into the air-pipe above so as to allow the apparatus to be emptied. It is probable that the workman will generally close this cock, for when the syphon is run out he has the trouble of filling it again before resuming work. He operates then with an arrangement which acts exactly like a common syphon, as when the cock is shut the lateral orifice does not communicate with the atmosphere.

A. de Hemptinne† constructed an apparatus for concentrating sulphuric acid down to 1·84 specific gravity under reduced atmospheric pressure without the use of glass or platinum. The apparatus is said to be in operation near Brussels, but is little employed elsewhere.

Baist and Rœssler, of the Greisheim Chemical Works, employ experimentally a modified platinum apparatus, as patented by Johnson and Matthey. In this arrangement only the lower part of the still which contains the acid, and is exposed to the furnace-gases, is made of platinum, the dome being constructed of lead. This apparatus does not cost half as much as an ordinary platinum still, but in practice it requires frequent repairs, since the lead is heated too strongly from below, and is too heavily weighted above by the refrigerating liquid.

Faure and Kessler, sulphuric acid manufacturers at Clermont-Ferrand (Puy de Dome), have sought to improve the construction of the platinum and lead concentration apparatus. This process is described in a pamphlet, "Notice sur les Appareils a Cuvette pour la Concentration à 66° B. de l'Acide Sulphurique."

The acid is heated in a very flat platinum pan of about 70 centimetres diameter. Over this pan is a very roomy lead chest, in which is condensed the weak acid which distils over. This construction affords a greater prospect of durability that the dome resting directly upon the pan, and the apparatus is said, in fact, to be capable of working for months without repairs. The inventors give in their pamphlet a comparative scale of cost, and mention as the principal advantages the following:

1. Decrease of first cost in the proportion of 300 to 350 per cent (?).
2. No wear and tear of platinum.
3. Decrease of 90 per cent of the loss in case of accidental injury to the still.
4. Economy of fuel.
5. Reduction of labour to the extent of 30 to 60 per cent.
6. Total abolition of the stoneware jugs used for filling the apparatus, and consequently no loss from their breakage.
7. Freedom from danger.
8. Greater regularity.
9. Reduced wear and depreciation of platinum, one-twentieth of ordinary amount. (But see No. 2 above.)
10. Great convenience for repairs.

An apparatus of Faure and Kessler's, costing 15,000 francs, is said to yield in twenty-four hours about 2500 kilos. of sulphuric acid at 66° B. An apparatus of the same power, entirely of platinum, can be had from Desmoutis, Quenessen, and Co. for 30,000 francs, even if the platinum costs 1000 francs, and not for 45,000 francs as assumed in the pamphlet. The first cost, supposing Faure and Kessler's system to hold good is only reduced 50 per cent.

The advantages Nos. 2 to 10 cannot be taken into consideration: stoneware jugs can be dispensed with in an ordinary apparatus, and the depreciation of the platinum pan must be increased, since in the ordinary construction it is precisely the lower part which suffers, whilst the weight of the dome and syphon remains approximately constant.

Stolberg, February 1, 1877.

(To be continued.)

* R. Hasenclever, *Dingl. Polyt. Journ.*, ccvi., 32.

† A. de Hemptinne, *Dingl. Polyt. Journ.*, ccv., 429; *Wagner's Jahresbericht*, 1872, 213.

CHRYSOLIN, A NEW YELLOW DYE DERIVED FROM RESORCIN.

By F. REVERDIN.

THE colouring matter of which we are about to speak, and which we have prepared since March this year at the works of MM. P. Monnet and Co. at Geneva, is formed by the simultaneous action of phthalic and sulphuric acid upon benzyl-resorcin.

Benzyl-resorcin is obtained very readily either by causing the chloride of benzyl to act upon resorcin in presence of a small qpantity of zinc-powder, or by heating an alkaline and alcoholic solution of resorcin with chloride of benzyl, or, lastly, by heating, to about 150° in the oil-bath, a mixture of 1 molecule of resorcin and of 2 molecules of chloride of benzyl.

The most simple manner of preparation consists in adding the chloride of benzyl, little by little, to the melted resorcin; a large quantity of hydrochloric acid escapes, and the mass becomes a reddish-brown. When all the

chloride of benzyl has been introduced it is heated to 150° in the oil-bath in a flask fitted with an ascending condenser until the escape of hydrochloric acid is at an end. The product of the reaction is poured into water, boiled to expel the last traces of chloride of benzyl, let settle, and decanted.

The compound thus obtained is a strongly-coloured oil, very thick, insoluble in water, in which it sinks; it distils at a very elevated temperature, with partial decomposition. It dissolves in alcohol with a yellow colour; the solution has a decided green fluorescence. Benzyl-resorcin is soluble also with a yellow colour in benzol, chloroform, and ether.

Preparation of Chrysolin.—The following method dispenses with the previous preparation of benzyl-resorcin:—We heat in the oil-bath to 130° to 140° in a retort of enamelled cast-iron—

Sulphuric acid	460 grms.
Common phthalic acid ..	1 kilo.

The latter substance is transformed, in this operation, into phthalic anhydride. We then introduce into the retort:—

Resorcin	1 kilo.
Sulphuric acid	460 grms.
Chloride of benzyl	1 kilo.

and heat gently in the water-bath. The heat may be removed when hydrochloric acid begins to escape, and the reaction continues spontaneously. When no more hydrochloric acid is evolved, which may ensue in three or four hours, the reaction is completed by heating for twelve hours in the oil-bath to 135° to 145°. It is then let cool, the solid product of the reaction is broken up and dissolved in dilute caustic soda. It is well to boil for a considerable time. When the residue no longer diminishes in volume, we filter and precipitate the acid colouring matter by means of hydrochloric acid. The precipitate is washed with cold water, dissolved in the quantity of carbonate of soda needful to saturate the acid, and evaporated to dryness. The soda-salt of benzylated fluorescein constitutes chrysolin.

Chrysolin appears, as a mass, with green metallic reflections, but is red-brown when reduced to powder, It is soluble in water and alkalies; its solutions, which present a magnificent green fluorescence, are precipitated by acids in yellow flocks. It yields bromated, iodated, and nitro-derivatives, which are all beautiful colouring matters.

Chrysolin may be fixed directly upon silk and wool. Wool, however, is preferably mordanted in a beck of acetate of lead and alum. Cotton is mordanted with sulphate of alumina and dyed at a hand-heat.

The shade of chrysolin approaches that of turmeric, and it resists the action of light well.

Yellow colouring matters may also be obtained by replacing the chloride of benzyl with the chlorides, bromides, and iodides of the fatty series. Methyl-resorcin, prepared by heating under pressure the resorcinate of soda in alcoholic solution with chloride of methyl, yields also a yellow colouring matter.—*Moniteur Scientifique.*

ON SCIENTIFIC RESEARCH IN RELATION TO TANNING.

By HENRY R. PROCTOR, F.C.S.

As I believe it is intended that this first meeting of our society* should discuss the best means of stimulating scientific inquiry about leather-making, I venture to put down a few remarks on the subject, rather with the hope of raising discussion than because I suppose that individually I can throw any important light upon it.

It is scarcely necessary, in the present day, to insist on the importance of science to business in general; it will be more to the point to particularise a few matters which specially claim attention in our own industry. Without doubt other members will add to the list of unsolved problems, and perhaps suggest lines of inquiry which are still more likely to be productive.

To begin at the beginning, we are far from knowing all about the softening of dried hides. The putrefying soaks which are used for the purpose must have an injurious effect on the fibre of the hide. By the addition of an antiseptic, such as carbolic acid, or some poisonous metallic salt to the water, this putrefaction might be checked, and the hides allowed to soak for much greater lengths of time without injury. It is doubtful, however, whether mere soaking without putrefaction will completely soften and swell the fibre, and by no process that I know can dried hides be completely restored to their natural plumpness. The green hide contains, between the gelatinous fibres, a glutinous liquid, like white of egg, which, on drying, sticks them together into a compact mass, and is very likely insoluble in cold water alone, while it is probably easily destroyed by putrefaction. Chemical research might soon decide whether this is the case or not, and might probably indicate a solvent at once quicker and safer than the common soak; or, on the other hand, might suggest a means by which, in the original drying, this glutinous substance might be kept in a soluble condition.

Turning next to the unhairing, it is admitted on all hands that liming, even if as yet the best process known, is far from perfect. It however serves the double purpose of loosening the hair and swelling the fibre of the hide; now, the hair is fixed in its sheath by a little bulb or root of greasy matter, and to loosen it, it is necessary that this should be dissolved. The swelling of the pelt has probably little to do with loosening the hair; sweating, charcoal, and sulphide of sodium (free from caustic alkali) will loosen the hair without raising the hide; and in some cases, extreme swelling has the effect of fixing the hair after it has been loosened. Weak acids will swell the pelt without any perceptible loosening of the hair. Which, then, of the known unhairing agents loosen the hair by acting on the fatty root, and which by softening the hide in general? is a question which we may well ask of science. Probably a careful study of the action of chemicals on sections of hide under the microscope would throw light on it.

The operations of raising and bateing are both very imperfectly understood. Both acids and alkalies are well known as raising agents, and both are capable of entirely dissolving the hide fibre. Under the microscope, the fibrous structure of a thin section of hide may be well made out, especially if it be slightly coloured with a solution of magenta, and pressed between two plates of glass. These fibres in their natural state are smooth and compact; under the action of raising agents they often become ragged and imperfect, and split into numerous finer fibres. Now, it is well known that to manufacture thick, solid, and heavy sole-leather thorough plumping is required, and this is perfectly comprehensible on Knapp's theory that tanning consists merely in depositing an insoluble coating on the surface of the fibres. Naturally, the more the fibres are subdivided, the greater surface they will offer to the deposit of tanning matter. It is important, however, that this sub-division should be accomplished with as little ragging and roughening of the fibres as possible, since this must weaken the leather and render it less elastic. Do acids or alkalies do this the best? Certain salts also have a plumping action. Do they also act as solvents? Given quantities of hide might be treated with various agents, and the amount of dissolved gelatine determined in the solution by methods well known to chemists. Determination of the nitrogen present by the ordinary methods of water analysis would afford a good measure of the gelatine.

Is the object of bateing solely to remove the lime, or is it also necessary to dissolve and work out the glutinous fluid which fills the pores of the hide? If the latter be

* British Leather Trades Association.

the case. It will explain the non-success of methods which aim simply at the former. Yet surely there are agents which will do both of these more economically than the putrefactive organisms which swarm in our pures. The action of the bate is always solvent and destructive to the hide, like that of raising agents. Why, and how, does one soften and make thinner, while the others swell and harden? Again the microscope must be appealed to, in conjunction with chemistry.

Passing on now to the tanning proper, it would be well to know whether Knapp's theory that tanning is merely a surface action can be substantiated. I, for one, have my doubts in the case of tanning proper, though probably it is perfectly true of tanning and chamoising. In these latter cases appropriate treatment will bring back the leather to the condition of raw hide, or at least dissolve the gelatine, which in the case of really tanned leather cannot be done. A piece of leather merely "struck through" will swell up in a solution of acetic acid, while the well-tanned is unaffected; now, if in this case the action was merely surface, the diffusible acid would certainly penetrate to and swell the centres of the fibres.

Again, how and in what form is the tannin deposited in sole-leather, and what is the difference between pieces of the same hide tanned for sole and for dressing purposes? It may be supposed that the more the fibre is separated by limeing, the softer a dressing leather will be, and the more stuff it will carry. This is not the writer's opinion from experience, though in the North of England shaved hides are commonly limed longer than sole-leather.

It is frequently said that the butts in their early stages are kept plump by gallic acid. Other and more powerful acids are invariably present, however, such as acetic, butyric, and lactic acids. Do these arise from souring and decomposition of the tannins, or rather from that of the sugar, starch, and gum which are always present? It is possible in many cases, if not in all, to check the fermentation of tannin by the use of suitable antiseptics, but it is not yet known whether this fermentation is due, like that of yeast, vinegar, &c., to some living organism, or rather to some peculiar ferment analogous to diastase and sinaptase. It is very possibly not only in the power of the tanner to prevent the fermentation and loss of the tannin, but to determine the fermentation of the sugar and gum, so as to yield acetic, butyric, or lactic acids, as may be found most desirable. Each of these ferments depend on a special organism, and the brewer has to examine his yeast (alcohol ferment) carefully to ascertain its freedom from the "false" ferments of acetic or lactic acid, which would sour and spoil his beer, and which even in small quantity causes most of the faults and disagreeable flavours to which beer is liable. Now, if the tanner introduces the lactic ferment instead of the alcoholic, he will similarly obtain lactic acid instead of alcohol. A solution of sugar, which with yeast will give alcohol, with the vinegar plant yields acetic acid, and with scrapings of decaying cheese or sour milk will yield lactic acid. There is no doubt that a thorough investigation of the fermentation of tannins is most necessary.

I must, however, limit my remarks, which have already claimed an undue amount of your time and patience. It is self-evident that any improvements in tannin estimation would be vitally important, that much—almost everything—remains to be known about the various tannins we employ, that methods of distinguishing and separating them are necessary and possible, and that the action of heat in their extraction needs investigation. Enough has been said to show the wide field which is open to the chemist—to quote in all seriousness the words which were applied to a still more important subject, "the harvest truly is plenteous, but the labourers are few."

It seems to the writer that if an adequate prize were offered for *any* valuable contribution to the science of tanning, the result would be better than if we attempted with our limited knowledge to map out a particular line of research. Even if no immediate money value was apparent, the knowledge would be certain to pay sooner or later, either directly or by leading to further discovery.

The writer has worked, and hopes to work further, at some of the problems he has mentioned, but business leaves him so little time for any research but what bears directly on the "demands of the day," that he would gladly welcome other workers, even in the same fields, and willingly help them by whatever information or suggestion he could give.—*The Leather Trades' Circular and Review.*

LABORATORY NOTES.

By T. A. EDISON.

HARD rubber or vulcanite, placed for several weeks in nitrobenzol, becomes soft and pliable like leather, and easily broken.

2. The vapour of chloral hydrate is a solvent of celulose. I have found the corks of bottles containing the crystals eaten away to the depth of a quarter of an inch, the cork being resolved into a black semi-liquid. Certain kinds of tissue paper are partially dissolved in time, if thrown in a bottle containing the crystals.

3. A very difficult substance to dissolve is gum copal. I have found that aniline oil dissolves it with great facility.

4. Hyposulphite of soda is apparently soluble to a considerable extent in spirits of turpentine. Large crystals of "hypo" melt down to a liquid after several weeks, and if the bottle be shaken, partially disappear. The turpentine smell nearly disappears.

5. The vapours of iodine, in the course of several months, will penetrate deeply into lumps of bees'-wax.

6. If to a solution of bisulphide of carbon there be added twice its bulk of potassic hydraet in sticks, and the bottle be well sealed, the whole will, in two months, become an intense reddish, syrupy liquid, with scarcely any free bisulphide of carbon.

7. Some substances in solution form crystals or deposits on the sides of the bottles containing them, generally above the water line. Among such solution in 100 c.c. of rain water way be mentioned a 14-grm. solution of acetate of uranium, 8-grm. do. of proto-acetate of copper, 5-grm. do. of acetate of morphine, 10-grm. do. of formate of copper, 20-grm. do. of tannate of iron. These deposits invariably take place on that part of the bottle most *exposed to light.* This phenomena may be due to heat, but deposits or films occur in some solutions *within the liquid* as well as above it—especially noticeable with tannate of iron, the film of which adheres strongly to glass.—*American Chemist.*

NOTICES OF BOOKS.

Annual Record of Science and Industry for 1876. Edited by SPENCER F. BAIRD. New York: Harper Brothers. London: Trübner and Co.

THIS annual publication continues to improve, and has certainly no rival in the English language. Its characteristic features, as compared with other works having the same general objects, are the following:—There is a general summary—or rather a series of summaries—of the progress made during the year in the various branches of science and industrial art. Upon this follow abstracts of papers, memoirs, &c., giving the details of research, invention, and discovery, the sources whence they are taken being fully given. The authorities selected are for the most part satisfactory; though one or two English journals might be considered as of doubtful value, and three French magazines might have been judiciously searched

for technological matter. We refer to the *Moniteur de la Teinture* and the *Bulletins* of the Industrial Societies of Mulhouse and of Rouen. As regards the classification of the abstracts, the editor very justly remarks that many paragraphs might be appropriately introduced under several heads, and he has therefore introduced a system of cross-references. Next follows the annual obituary of scientific men, succeeded by a list of the most important scientific works which have appeared during the year. There is an elaborate alphabetical index of authors and subjects, a systematic table of contents, and a list of the authors whose co-operation the editor has enjoyed in the compilation of the book, and especially in the preparation of the summaries of scientific progress. The majority of the physical and chemical facts mentioned will, of course, have come under the notice of our readers, which, however in no manner detracts from the value of the "Record" as a key to the scientific history of the past year, and a general note-book of discovery and invention. Mention is made of Davy's test for alcohol—a solution of molybdic acid in strong sulphuric acid. This reagent is said to produce a blue colouration if only the $\frac{1}{1000}$ of a grain of alcohol be present.

The use of certain deliquescent salts for watering streets, in particular chloride of calcium, is mentioned as having been discussed in the French Academy. M. Houzeau is probably not aware that an English patent for this idea is in existence, and has been in actual operation in one of the metropolitan parishes.

Guyard, we are told, has "thrown considerable light on the formation of aniline-black by the discovery that the salts of vanadium have a marked influence in producing it." This passage would lead a reader not especially acquainted with the subject to think that this action of certain vanadium compounds was due to Guyard. Yet the late John Lightfoot, the original discoverer of aniline-black, distinctly mentions this influence of vanadium, as has been fully pointed out by Rosenstiehl. Pinkney, also,—we believe without being aware of what Lightfoot had done—claimed in his patent the use of vanadium for the production of aniline-black before the subject was taken up by Guyard.

Mention is made of the experiments of Böttger, Lippmann, and Neison, with the radiometer, but curiously enough there is no reference to the experiments undertaken by Mr. Crookes, and described in papers read by him at various times from March 30 to November 16, 1876, and which must certainly be regarded as no unimportant steps towards a correct theory of the phenomena in question.

Still, notwithstanding such oversights, difficult to avoid in a work of this nature, we can strongly recommend the "Annual Record" as the best book of its kind with which we have become acquainted.

A Handbook for Young Brewers. By Herbert Edwards Wright, B.A. London: Crosby Lockwood and Co.

The object of this little work is to present, in brief outline, the scientific principles upon which the art of brewing is based. The author treats in succession of barley, malting, and malt; of water, hops, and sugar; of mashing and boiling; of fermentation in the three forms most important to the brewer, viz., the alcoholic, the lactic, and the acetic, with an exposition of the rival theories of Liebig and Pasteur; of pale ale, black beers, bottling, and export. There is also a notice of the present and still undecided controversy between Dr. Bastian and Professors Tyndall and Pasteur on spontaneous generation. On most of the subjects touched upon the author evidently speaks as a man of practical experience. Speaking on the subject of water, he divides its possible impurities into hurtful and useful, including, under the former head, organic matter, nitrates, nitrites, ammonia, and iron; whilst the sulphates, carbonates, and chlorides of calcium, magnesium, potassium, and sodium are, for the brewer's purpose, to be regarded as useful. Nitrates he pronounces to be the principal food of bacteria. Now, as it is asserted that much of the organic nitrogen present in sewage reappears in the effluent of irrigation farms in the form of nitrates, if this view is correct, such water must be a formidable source of contamination to the streams into which they fall. As a test for organic matter, the permanganate of potassa is recommended, but without the necessary caution that ferrous salts will produce the same reaction. "A pound of dry gypsum," says the author, "may be reckoned as seven thousand grains." We should think that this must be approximately true of a pound of any substance. In the last chapter, on "Hiring and Letting Public-houses," the author leaves the regions of science, and reveals trade practices with which the public at large can have little sympathy. It must, however, be admitted that in this system of securing customers the brewers are no longer singular. We think we could point out drysalters who contrive to get dyers into their power, though, of course, in a manner modified to suit the different circumstances of the case; and we know also of paper-makers who have letter-press printers bound by agreement to use their paper at certain prices and no other. With the political, economical, and social phases of this system we have here nothing to do, but we feel bound to denounce it on behalf of the industrial arts. The man who has secured a set of compulsatory customers will care little about introducing improvements in his manufactures, and will thus contribute quite as much as any trades-union to drive important branches of industry abroad.

Upon the whole, the little work before us is a judicious attempt to bridge over the gap between theory and practice in a very important branch of chemical technology, and, as such, it has our best wishes.

Inorganic Chemistry, adapted for Students in the Elementary Classes of the Science and Art Department. By Dr. W. B. Kemshead, F.R.A.S., F.G.S. (Enlarged Edition). London and Glasgow: W. Collins, Sons, and Company.

The book before us is one of those elementary treatises on chemistry which have become, of late years, so numerous, and whose existence certainly proves that this science is attracting the attention of an increased number of persons, either from an honourable desire to "know," or from a more questionable ambition to "pass." The latter point of view is made here, to say the least, quite sufficiently prominent. We are told, in the outset, that the work is "written with an especial purpose, viz., for the use of pupils preparing for the first stage or elementary examination of the Science and Art Department, South Kensington;" and that, as such, "it necessarily confines itself to the subjects prescribed in the syllabus of that examination." Whilst declaring that he makes "no apology for introducing the graphic formulæ," the author adds that "the examination for which this book is specially prepared demands a knowledge of the theory of atomicity, and of its graphic representation, &c." Dr. Kemshead concludes his preface as follows:—"The work, while in the form of notes, has done good service in preparing my own pupils for the South Kensington examination; I trust that it may be equally successful in the hands of those teachers who may adopt it." We think we have known professors whose standard of "success" or of "good service" was somewhat different.

The body of the work is devoted to the consideration of the general laws of chemical combination to nomenclature, classification, and atomicity, followed by a description of seven of the non-metallic elements and their respective combinations. The facts are, of course, the same as the reader may find in other manuals, and the

point of view from which they are regarded will be at once foreseen by any chemist who reads the preface. It must not be imagined that we pronounce the book useless. So long as the present system of regarding science in [illegible] be examined in shall endure, so long works like that before us will have no unimportant part to play. They answer their purpose, but that purpose is, in our opinion, not the highest.

CORRESPONDENCE.

PHOTOGRAPHING SPARK SPECTRA.

To the Editor of the Chemical News.

SIR,—It may interest some of your readers to know that the spark spectrum from a 6-inch spark induction-coil may be very easily photographed, and that by moistening platinum points with HCl solutions of the metals very beautiful spectra may be obtained. In this way I have obtained spectrum photographs of Bessemer steel and iron. I have the whole apparatus so arranged as to render it easy to photograph the spectra of HCl solutions of steel, pig-iron, and iron ore very quickly, the whole process first to last not exceeding thirty minutes.

It required six Grove's cells to work the coil, but finding this battery required constant changing and refitting, thus involving loss of time and trouble, I fitted up 50 Bunsen cells, using a mixture of undiluted sulphuric and nitric acid ($\frac{8}{3}SO_3\frac{1}{3}HNO_3$) for the inner porous cell, and water only on the outer. This battery lasts six days, at the end of which time it is only necessary to renew the acid in one-third of the inner cells; consequently the battery lasts three weeks. It is then only necessary to syphon off the acid from the porous cells and refill, which is very soon done. I have tried various forms, but have found none to equal this for regular and constant work. I have used Bunsen's improved bichromate battery, said to be very powerful and constant, but I have not found it so good as represented. I use a single prism spectroscope, and by the usual combination of lenses photograph an enlarged image of the spectrum.

The light from the spark alone being very feeble, it requires prolonged exposure to bring out the image; indeed, I have repeatedly failed to get a good photograph of the spectrum. I found it was necessary to burn small lengths of magnesium wire just behind the spark. The additional light therefrom appears to shorten the time of exposure, fifteen minutes being ample. I use about 30 inches magnesium in twelve lengths during the fifteen minutes' exposure.

I have lately discontinued the use of wet plates, and use only the uranium dry plates; these, of course, are available for any length of time. It is common to leave the plate in the camera for hours, taking several spectra on one plate, and developing all together.—I am, &c.,

J. PARRY.

Laboratory, Ebbw Vale Iron Works.

CONVERSION OF THE NORMAL PARAFFINS INTO THE BENZOLE SERIES.

To the Editor of the Chemical News.

SIR,—May I have a space as of old in your hospitable pages for a discovery which I think is of considerable interest both to scientific and industrial chemistry—conversion of the normal paraffins into the benzol series.

Here, in the United States, there are several methods of making illuminating gas from petroleum by passing it into heated retorts. I was informed by Mr. John Lerltus, of East Boston, that the tar from these gas-works resembled very much the tar from coal-gas. I examined a specimen of this tar and found that it did contain the benzol compounds, but not either phenol or cresol.

This points very distinctly to the decomposition of the normal paraffins of petroleum into the benzol compounds on a rather large scale. It seems to me that it might lead to the obtention of benzole by passing petroleum benzine (which sells here at about 7 to 8 cents per gal.) through tubes heated to the proper temperature. In connection with the manufacture of gas the yield, even if quite small, might be made to pay. At all events the new methods of gas-making will still afford us a source for benzole and its derivatives.—I am, &c.,

S. CABOT, Jun.

Boston, August 20, 1877.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

AUGUST, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 ft. of Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Anhydride. Sulphuric	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Clear	0·000	0·007	0·099	0·024	18·40	7·560	0·360	0·94	1·130	12·1	3·00
West Middlesex	Clear	0·001	0·007	0·090	0·048	16·00	6·440	0·250	0·94	1·200	12·6	3·00
Southwark and Vauxhall	Slightly turbid	0·000	0·007	0·105	0·052	16·70	6·830	0·280	0·94	1·060	12·1	2·40
Chelsea	Slightly turbid	0·000	0·009	0·133	0·021	18·60	7·890	0·320	0·94	1·330	13·2	3·00
Lambeth	Clear	0·000	0·008	0·135	0·077	17·70	7·560	0·320	0·94	1·260	13·2	3·30
Other Companies.												
Kent	Clear	0·000	0·002	0·375	0·003	28·00	10·860	0·930	1·44	3·200	19·4	5·60
New River	Clear	0·000	0·009	0·129	0·024	17·90	7·720	0·390	0·94	0·860	12·6	3·00
East London	Clear	0·000	0·006	0·105	0·063	17·90	7·220	0·320	1·01	1·330	12·1	3·75

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. No. 9, Aug. 27, 1877.

Relation which should exist between the Diameter of the Iron Nuclei of Electro-Magnets and the Thickness of their Magnetic Coils.—M. Th. du Moncel.—For a given resistance in the circuit and with a sufficient electric intensity, the electro-magnet the thickness of whose helix is equal to the diameter of the iron has the advantage.

Observations Relative to a Recent Note by M. du Moncel on the Best Conditions for the Use of Galvanometers.—J. Reynaud.—Not adapted for abstraction.

No. 10, September 3, 1877.

Compounds of Hydrochlorate of Ammonia with the Chlorides of Potassium and Sodium.—E. Chevreul.—The author has found in guano cubic crystals formed of the chloride of sodium and the hydrochlorate of ammonia. His experiments leave no doubt as to the affinity existing between these two salts.

Considerations on the Interpretation which ought to be given to the Conditions of Maxima Relative to the Calculations of Electro-Magnetic Forces.—M. Th. du Moncel.—A reply to the observations of M. Reynaud in *Comptes Rendus*, Aug. 27.

Researches on the Phosphoric Acid of Arable Soils.—B. Corenwinder and G. Contamine.—Having found that in a field planted with beet-root 600 to 700 kilos. of superphosphate per hectare increase notably both the yield and the percentage of sugar in the roots, an investigation was commenced on the quantity of phosphoric acid present in the arable soils of the north of France. In the canton of Houdain (Pas de Calais) M. Woussen found in the soil dried at 100° an average of 1·146 grm. per kilo. The authors at Lille found, under the same circumstances, 1·265 grm. Admitting that on the average the soil of a field contains 1·1000 of phosphoric acid, we may calculate that in a hectare of surface and 35 centimetres in depth there will be found 4900 kilos. of phosphoric acid.

Certain Derivatives of Ethyl-vinyl.—M. Milan Nevoté.—The facts presented in this memoir confirm the supposition entertained some time back that the structure of butylen (ethyl-vinyl) derived from the action of zinc-ethyl upon bromide of vinyl is $CH_3-CH_2-CH=CH_2$.

Justus Liebig's Annalen der Chemie, Band 188, Heft 1 and 2.

Researches from the Laboratory of Professor Fittig.—These consist of a paper on Isomeric Sulpho- and Oxy-naphthoic Acids, by Martin Stumpf; a Memoir on Chloro-bromanilin, by R. Fittig and E. Büchner; a paper on the Behaviour of Para-brom-anilin at Elevated Temperatures; a Treatise by Ernst Ihlée on Pyromeconic Acid, and a series of investigations on the non-saturated acids. This last paper is divided into the following sections:—On the Crotonic Acid formed from Citraconic Acid and Mesaconic Acid, by A. C. Prehn; on Methacrylic Acid, by P. Ludwig; on Xeronic Acid, a New Derivative of Citric Acid, by R. Fittig; on the Addition-Products of Ita- Citra- and Mesa-conic Acid, by R. Fittig and A. Landolt; on the Behaviour of Fumaric and Maleic Acid with Fuming Hydrobromic Acid, by L. Dorn; and on the Constitution of the Non-saturated Bibasic Acids, R. Fittig.

Behaviour of Acid Chlor-anhydrides with Zinco-Organic Compounds.—D. Pawlow.—A very lengthy paper, unfit for useful abstraction.

Communications from the Chemical Laboratory of Greifswald.—These consist of a paper by Dr. U. Sachse on Dinitro-sulpho-benzolic Acid, and one by G. Heinzelmann on Certain Derivatives of Meta-disulpho-benzolic Acid.

Chemical Compounds in Liquid Storax.—Dr. W. v. Miller.—The author doubts the formation of metastyrol in storax. Cinnamic acid was found in quantity. Vanillin is not present, but there seems to be a certain amount of ethyl-vanillin. Cinnamic acid phenyl-propyl-ester was found in rather considerable quantity, cinnamic acid ethyl-ester in smaller amount. Two alcoholic bodies, α- and β-storesin, exist in a not insignificant amount, as also the cinnamic esters of these alcohols. The sodium compound of storesin is met with in very small quantity, and also a resinous body accompanying the ethyl-vanillin (?).

Communications from the Laboratory of the University of Würzburg.—These consist of a paper by Dr. M. Conrad on Acet-succinic-ester and its Derivatives; a memoir by H. Rohrbeck on α-methyl-β-oxybutyric acid, and α-methylcrotonic acid; and one by E. Waldschmidt on α-ethyl-β-oxybutyric acid and ethyl-crotonic acid.

Normal Paraffins.—Dr. Carl Schorlemmer.—An examination of normal hexan and normal heptan.

Heft 3, Aug. 9, 1877.

Communications from the Laboratory of the University of Würzburg.—These consist of a paper by R. Saur on Ethyl-methyl-acetic ester and on α-ethyl-methyl-β-oxybutyric acid; a memoir by Dr. Max on Metalacetic ester.

Combinations of the Elements of the Nitrogen Group with the Radicals of the Aromatic Series; Part II. On Aromatic Phosphorus Compounds.—A. Michaelis.

Substituted Phosphenylic Acids.—The compounds here examined are nitro-phosphophenylic acid with a number of its salts, amido-phosphenylic acid, and nitric diazo-phosphenylic acid, $C_6H_3N_2O_3PO_3H_2+3H_2O$.

Miargyrite and Kenngottite.—L. Sipöez.—The author finds the composition of the former mineral to be—

Sulphur	21·80
Antimony	41·65
Silver	32·77
Lead	1·01
Copper	0·51
Iron	0·19
	99·96

This result approaches very closely to the analyses of Rose and Breithaupt performed respectively upon specimens from Braunsdorf and Przibram. The composition of Kenngottite was found to be—

Sulphur	20·66
Antimony	39·46
Silver	35·28
Lead	1·76
Copper	0·50
Iron	0·25
	97·91

Contributions to a Knowledge of Pyruvic Acid.—Dr. C. Bœttinger.—The dry distillation of tartaric acid does not lead to the production of pyruvic acid without loss. The constitution of this acid cannot be explained from the manner of its formation. The behaviour of pyruvic acid with hydrogen, sulphuretted hydrogen, and hydrocyanic acid corresponds to the properties of a keton. The action of ammonia and of anthranilic acid upon

pyruvic acid leads to bodies which give no clue to the constitution of the latter acid.

Dinitroso-orcin and Dinitro-orcin.—J. Stenhouse and C. E. Groves.—From an English source.

Biedermann's Central-Blatt fur Agrikultur Chemie, Heft 5, May, 1877.

Composition and Properties of Drinking Waters, and of Waters Serving for General Domestic Use.—Dr. August Voelcker.—Taken from the *Journal of the Royal Society of England*, vol xi., part 1, No. 21.

Conduction of Heat in Soils.—Prof. F. Haberlandt.—The conduction of heat is most rapid in rocks and is approximately in proportion to their specific gravity. Soils, especially if of loose texture, containing many spaces filled with air are relatively bad conductors. A soil saturated with moisture and puddled into a dense condition conducts heat better than water. Of the four kinds of soil tried common arable earth was the best conductor, then sand, then peat-earth, and lastly compost. It is an error to suppose that soils rich in humus are necessarily warm; the influence of their dark colour extends merely to the upper layer.

Researches on the Ash of Blood.—A. Jarisch.—It is remarkable that while in man and in the horse the quantity of potash exceeds that of soda, in the ox and especially in the dog it is very much smaller.

Experiments on the Respiration of Plants.—Dr. L. Rischawi.

The Dependence of the Respiration of Plants upon Temperature.—Prof. A. Mayer.—Not suitable for abstraction.

Analyses of Certain Plants.—A. H. Church.—This paper gives the proximate composition of the leaves of lettuce, Iceland moss, water-cress, and wheat; also of the leaf-scales of the beech and the female blossoms of the elm.

Composition of the Tubers of Dioscorea Adulis. Prof. J. Moser.—The roots of the yam showed on analysis:—

	Moist.	Dry.
Water	60·722	—
Ash, freed from carbon, carbonic acid, and sand..	0·895	2·278
Nitrogenous matters	4·185	11·119
Extractive matter soluble in—		
Ether..	0·348	1·561
Alcoholic sulphide of carbon	0·265	
Cane-sugar	4·790	12·195
Levulose	0·180	0·458
Starch	25·185	64·121
Pectin and non-azotised extractive matter	2·033	5·176
Cellulose	1·091	2·785
Sand	0·003	0·007

Proportion of Potash in the Wood and Sap of American and European Vines.—Dr. Curt Weigelt.—Those species which contain most potash are least affected by the attack of the phylloxera.

Influence of Rain and Light upon the Sugar-Beet.—Dr. H. Leiem.—The action of light in the production of sugar in the beet-root is unimportant, and its place can be fully supplied by heat.

Heft, 7, July, 1877.

Amount of Carbonic Acid present in the Air during Winter.—M. P. Truchot.—The amount of carbonic acid contained in the atmosphere in winter varies inversely with the position of the barometer. When the ground is not covered with snow, the average proportion is not greater than during summer. Snow increases the quantity of this gas in the atmosphere.

Chemical Examination of the Drinking Water at Hohenheim and Birkach.—G. Dittmann.—The author determines the organic matter present in water by means of permanganate of potassa. The sub-editor, Prof. E. von Wolff, remarks in a note that a really quantitative determination of the organic impurities in water has not yet been found practicable. Among the characteristics of a polluted water, the author includes the presences of potassa and soda otherwise than in mere traces. He recommends that towns should be supplied with mountain waters.

Investigations on the Diffusion of Carbonic Acid through Porous Partitions, being a Contribution to the Question of the Penetrability of Building Materials by Gases.—Prof. Max Märcker and Dr. E. Berthold.—Among the materials which allow the passage of air are brick, sand-stone and calcareous tufa, whilst granite, porphyry, slate, shelly lime-stone, marble, and alabaster are impenetrable. Machine-made bricks are less permeable than those moulded by hand. Strong burning increases the porosity of bricks, but as soon as fusion sets in they become impenetrable. Pine and oak wood, in their longitudinal sections are very slightly pervious. Mortar is a very porous material, and its permeability decreases but very slightly in the course of time. Cement, when recently hardened, is highly porous, but if kept under water, or exposed to rain, its porosity is destroyed. Thin paper hangings reduce the permeability of a wall by 17 per cent, but thick glazed hangings occasion a loss of 40 per cent. A double coating of oil-paint renders all building materials impermeable. The application of water destroys more or less permeability, and a considerable time must elapse before it is restored.

The Absorptive Power of Soils for Watery Vapour and its Bearing upon Vegetation.—Prof. R. Heinrich.—The author concludes that the water required by plants must be supplied to the soil in a liquid state, as rain, dew, &c. The common opinion of the utility of the absorptive power of soils for gaseous water is therefore an error. Neither the various cultivated plants, nor those known as swamp or sand plants, have any essentially different power of extracting hygroscopic moisture from the soil.

Action of Sea Water upon the Soil.—G. Reinders.—Among the injurious consequences are the increase in the amount of chlorine, which may rise to 0·25 per cent. The chlorides of calcium and magnesium have a notable effect in retaining an excess of moisture. The reduction of the sulphates in presence of organic matter is also injurious.

Examination of the Milk of Cows of Auvergne.—M. P. Truchot.—The author concludes that during summer the milk of the Salers race is poorer in butter, but richer in casein than in winter. The Ferrand race yield a little more butter and a little less cheese. As regards the Charollais breed, the main constituents of the milk fluctuate very little. The milk of Normandy cows contains much butter and little casein. The reporter expresses some doubts as to the trustworthiness of the author's analytical methods.

Les Mondes, Revue Hebdomadaire des Sciences, Aug. 11, 1877.

The *Union Medicale* concludes a fervid eulogium of M. Pasteur to this effect:—"In all branches of learning, and in all the sections of the academies, we find expositors and demonstrators such as can be met with neither in verbose and diffuse England nor in misty and pretentious Germany!"

Aug. 18, 1877.

The Mousseron Stove.—A considerable part of this issue is taken up with an account of a stove which is to utilise all the heat derived from the fuel, to require no

chimney, produce no smoke, and generate no carbonic oxide.

Aug. 25, 1877.

The experiments with the electric light on the system of Jablochkoff are proceeding very satisfactorily, and the light produced, though equal to that of 500 Carcel burners, is not oppressive to the eyes.

MM. Picon, distillers, of St. Denis, have caused their establishment to be illuminated by the electric light. The expense does not exceed 1 franc per hour, for each focus equals 250 burners. The railway station at Lyon is also definitely fitted up with the electric light on Lontin's system.

According to M. Jos. Henri, secretary of the Smithsonian Institution, the planet Mars is found to be attended by two satellites.

Dr. Sachs, of Berlin, has spent ten months in Venezuela for the purpose of studying the properties of the electric eel, and is said to have ascertained a number of interesting facts.

Wine is often injured if put into bottles made of a glass containing an excess of lime or of alkali. The best glass for wine bottles consists of—

Silica	58·4
Potassa (or soda)	11·7
Lime	18·6
Alumina and iron	11·0
Undetermined	0·3
	100·0

Inferior bottle glass sometimes contains 18 to 20 per cent of lime.

Aug 30, 1877.

This issue contains no original chemical matter.

Sept. 6, 1877.

The Helvetic Society of Natural Sciences held its sixtieth annual meeting at Bex (Vaud) on the 20th of August.

Moniteur Scientifique, Quesneville.
July, 1877.

The chemical matter in this issue consists almost exclusively of papers which have been already noticed, or of translations of English memoirs.

Researches on the Aromatic Amines.—MM. Noelting and J. Boas Boassen.—This paper consists in an examination of monomethyl-aniline, which the authors find is often present in small quantity in the commercial dimethyl-anilines and even in a sample of diethyl-aniline. To detect it they dissolve the sample in question in an excess of hydrochloric acid, moderately concentrated; add a few drops of a solution of nitrite of soda, and agitate with ether. The ether is then dried with chloride of calcium and evaporated in a watch-glass. Methyl-phenyl-nitrosamine remains as a yellow oil, and may be readily recognised by its characteristic odour. With phenol and sulphuric acid even a small quantity gives Liebermann's reaction very distinctly. Pure dimethyl-aniline gives not a trace of oil.

Rapid Determination of Potassa and Soda.—M. Ferdinand Jean.—The saline mixture in which it is desired to determine the potassa and soda is ground up with an excess of sulphate of ammonia, moistened with a few drops of water, heated to redness in a platinum crucible till the ammoniacal salts have completely disappeared, and treated once more with sulphate of ammonia in the same manner, so as to ensure the expulsion of all acids capable of displacement by sulphuric acid. The substance is then dissolved in boiling water, a slight excess of baryta-water is added, and the sulphates and insoluble matters are removed by filtration. The filtrate is then treated with a little seltz-water, and kept at a boil till all excess of carbonic acid has been expelled and all the carbonate of baryta rendered insoluble. The solution is then filtered, when the potassa and soda remain in the filtrate in the state of carbonates, and are exactly neutralised with a standard solution of hydrochloric acid at the boiling-point. In this neutral liquid the weight of the chlorides present is determined by bringing the solution—by evaporation or by the addition of water, as the case may be—to a volume of 50 or 100 c.c., the specific gravity of which is then determined. Or the solution may be evaporated to dryness, and the residue may be weighed. Knowing, therefore, from the quantity of hydrochloric acid used in titration, the weight of chlorine corresponding to the two alkalies and the weight of the two chlorides, it is easy to calculate the proportions of potassa and soda. If the chlorine found is multiplied by 2·1029, the weight of the chlorides subtracted from the product, and the remainder multiplied by 3·6288, we obtain the weight of sodium chloride, whilst the difference will be the potassium chloride. If it is required to determine alkalies in presence of a superphosphate, it is prudent to neutralise with baryta-water before the sulphatisation, to prevent the formation of pyrophosphates.

Apparatus Useful in Evaporation.—M. F. Jean.—Solutions of silica, alumina, &c., or of substances disposed to climb up the side of the capsule, may be safely evaporated in a very simple apparatus. The capsules are placed in a fire-clay muffle resting on a base of bricks. The sides and top of the muffle are encaged with iron bars to receive fuel. The muffle is thus heated from the top and sides only. A suitable pipe introduced into the muffle carries off the vapours.

Reimann's Färber Zeitung,
No. 29, 1877.

This issue contains nothing of general interest.

No. 30, 1877.

A considerable part of this issue is devoted to an account of the new German Patent Law.

Sensational paragraphs on poisoning cases arising from confectionery coloured with artificial ultramarine are circulating in the German literary and political papers.

Laque serin is a yellow extract introduced into commerce by Messrs. Bayer, of Leipzig, and recommended as useful both to the dyer and the printer. Nothing is said concerning its origin or its chemical composition.

Professor A. W. Hofmann reports on a new orange colouring-matter having for its basis the radicle of naphthalin, and connected probably with chrysoidin.

No. 31, 1877.

Horseradish, dyed with magenta, is served up in certain eating-houses in Berlin as an accompaniment to what the editor calls "rum steak."

Professor Wagner communicates the commencement of a paper on rosolic acid and its relation to rosanilin.

No. 32, 1877.

The editor is about opening a college for the special study of the scientific principles of dyeing and printing.

Cases of severe illness are said to have been occasioned by raspberry juice coloured with magenta. Dr. Reimann traces the evil, not to the colouring matter, but to the spurious character of the liquid sold under this name, which in many cases is quite artificial, and contains not a trace of raspberries.

No. 33, 1877.

Dr. Martius formally denies the statement of Fr. Bayer and Co. that "aurantia" is to be regarded as a dangerous colour on account of its poisonous properties.

Blue ultramarine, if heated above 160 along with water in a closed tube, is convered into green.

According to Guyard, the proportion of vanadous chloride required for the preparation of aniline-black is 1 per cent of the weight of the hydrochlorate of aniline. According to Gouillon, only 1-20,000th part of the vanadium salt is required.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. Aug., 1877.

Report Presented by M. Debray on Behalf of the Committee of Chemical Arts on the Top adopted to Gas-Burners by M. Biver.—Supplied to Bunsen burner serving at intervals for numerous chemical operations. In order to economise gas and to save the apparatus which is rapidly injured if kept constantly burning with a large flame, we may extinguish the burner and rekindle it when needed. But this operation if often repeated is a loss of time and an annoyance. M. Biber has arranged a regulating tap enabling the supply of gas to be diminished without fear of the flame "striking back," and effecting at the same time a better regulation of the heat produced. The details of the arrangement cannot be explained without the accompanying illustrations.

Report Presented by MM. Cloëz and De Luynes on Behalf of the Committees of Chemical and Economical Arts on the Optical Glasses of M. C. Feil.—A laudatory notice of the flint-glass made by M. Feil. The chemical composition of the glass is not stated, but the specific gravity of this flint-glass for optical purposes is stated as 3·537 to 3·659, and for photographic purposes from 3 to 3·13. His crown-glass varies from 2·465 to 2·504 in the former case, and from 2·540 to 2·90 for the latter. It is asserted that flint-glass, like photography, is "purely a French invention."

Report on the Procedures for the Regeneration of Peroxide of Manganese in the Manufacture of Chlorine, and on the claims of Mr. W. Weldon to the great Lavoisier Medal.—M. A. Lamy.—This report fully justifies the Committee of Chemical Arts in their unanimous award of the medal to Dr. Weldon, and includes an account of the theory and practice of the process. The author remarks significantly that in Belgium the absence of import duties upon English chemicals has almost entirely suppressed the manufacture of chlorine.

Report presented by M. Troost on behalf of the Committee of Chemical Arts on a Memoir on the Working of the Californian Borax Mines.—The boracic minerals are lixiviated at a boil in large wooden cisterns holding about 14,000 litres. When the liquid rises to 28° B., the clear portion is run off into crystallising tanks 3 metres long, 2 high, and 1 in width, where the solution cools slowly down to 25°, which may take from 6 to 10 days. When it gets below 28° the process is watched, so as to get rid of the mother-liquors before sulphate of soda is deposited. When the mother-liquor is run off, there is also an escape of mud mixed with octahedral crystals of borax, which are washed in the mother-liquor of the next operation, and preserved to be refined. At the bottom of the tanks is a deposit of borax, sometime 15 centimetres thick, which is broken up with pick-axes and washed.

Patent Printed Pills.—We have received from Messrs. Burgoyne, Burbidges, and Co., specimens of their Patent "Star" Coated and Printed Pills. These pills are certainly a novelty, each being distinctly printed either with its formula and dose, or with a number or some other distinguishing mark; and, in addition to bearing its name and dose, the coating—which is said to be purely vegetable and of an absolutely innocuous description—of each sort of pill is made of a distinctive colour, so that there is no difficulty in separating them, or in selecting them for administration.

TO CORRESPONDENTS.

We cordially thank those gentlemen who have kindly supplied us with the requisite information relative to the various Examining Boards, Colleges, and Schools of Chemistry given in the present number.

NOTICE.

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THE CHEMICAL NEWS.

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ON THE

ESTIMATION OF NITROUS AND NITRIC ACID.*

By G. LUNGE, Ph.D.,
Professor of Technical Chemistry, Polytechni um, Zurich.

Some time ago I proposed to myself to study the action of sulphur dioxide on the solution of chamber-crystals, or, more scientifically speaking, of nitrosulfonic acid,—

$$SO_2(OH)(NO_2),$$

in sulphuric acid, which constitutes the acid flowing from the "absorbing columns" of sulphuric acid works, and which is commonly called "nitrous vitriol." Although this action is utilised every day on a very large scale in most sulphuric acid works—viz., in all those employing the denitrating columns invented by Mr. Glover, and bearing his name—there are great varieties of opinions existing as to its nature. Some of the contradictions arising out of these controversies, which have been more particularly carried on in German periodicals, appeared to me to arise from imperfect modes of testing for nitrous, and perhaps even for nitric, acid, and it thus became the first portion of my task to thoroughly examine at least those methods of estimating the acids of nitrogen which have been proposed or used tor testing "nitrous vitriol."

I. *Estimation of Nitric Acid.*

One of the oldest and probably the most widely-used method of estimating nitric acid is that first proposed by Pelouze, but considerably modified afterwards by Fresenius, viz., dissolving metallic iron in hydrochloric or sulphuric acid, adding the compound containing nitric acid, or one of its salts, heating till the action of NO_3H on the ferrous salt is complete, and all NO is given off, and estimating the unoxidised portion of the ferrous salt by means of potassium bichromate or permanganate. In the latter case sulphuric acid must be employed for dissolving the iron. If the air has access to the liquids during these operations there may be some oxidation of ferrous to ferric sulphate, at the expense of atmospheric oxygen; but a more serious source of error is the regeneration of nitrogen acids from the evolved NO, which act again upon ferrous sulphate, and thus too high a proportion of nitric acid is indicated by the process. The process, as originally proposed by Pelouze, is certainly altogether faulty; but it became most accurate when Fresenius proposed to conduct the operation with a number of precautions, the most important of which is the carrying on of the whole process in an atmosphere of carbon dioxide. The process of Fresenius is, however, somewhat lengthy and complicated, and entails the use of cumbrous apparatus, and this would militate against its use in many, especially in all works', laboratories. A modification is therefore adopted by very many chemists, consisting in dispensing with the current of CO_2, but conducting the operation of dissolving the metallic iron and partly oxidising the solution by nitric acid or its salts in a flask, fitted with a Bunsen's india-rubber valve; that is to say, a cork, through which passes a short glass tube open at both ends, but closed at the outer ends by means of a small piece of india-rubber tubing, and a bit of glass rod stopping the latter again. The india-rubber tubing is provided with a sharp longitudinal incision of about 1 centimetre's length, which allows any gas or vapour to pass out, but none to enter into the tube, and thence into the flask. In this apparatus the steam arising from the boiling liquid soon expels the air, and prevents its injurious action upon the accuracy of the process; nor can the air enter again on cooling, as the valve prevents it from doing so, so that a vacuum is formed in the flask which ought to be of strong glass to resist the atmospheric pressure. This apparatus is so very simple that even the smallest laboratory can use it; but doubts have arisen whether the results obtained by it are really trustworthy. I have therefore made with this apparatus a number of experiments (nine), in which I worked with every possible precaution against error, and in which I employed exactly known quantities of nitric acid or potassic nitrate. In order to save the time consumed by cleaning, accurately weighing, and dissolving the iron wire, I employed in this series of experiments, as well as in all those following, a solution of pure ferrous sulphate (100 grms. per litre), acidulated with 5 per cent of sulphuric acid. Of this solution a certain volume, more than sufficient for the nitric acid contained in the test liquid, was employed, and a similar volume was tested at the same time by a standard solution of potassium permanganate; one such standardising of the iron solution is sufficient for a whole day, as the free acid prevents its too rapid oxidation. The potassium permanganate solution itself was made from pure crystals and standardised once a week with pianoforte wire in the same apparatus (taking 100 wire to contain 99·6 Fe): it was found to be unchanged after a month's standing.

The time consumed by each test till the NO was completely driven off was very inconveniently long, unless a large quantity of free acid was present, say 20 parts of SO_4H_2 to each 100 parts of liquid. If there is less acid present, the reaction—as shown by the colour of NO dissolved in the solution of the ferrous salt—goes on extremely slowly, or, with great dilution, not at all, until by prolonged boiling the above concentration has been reached. It is therefore convenient to add a sufficiently large quantity of pure strong sulphuric acid at once, in order to hasten the process. A pinch of sodium bicarbonate may be thrown in as well to fill the vessel with CO_2, but my results were as accurate without as with this modification.

With proper precautions, especially if the concentration and temperature of the liquids are not such as to cause an instantaneous reaction before the air has been expelled from the apparatus by aqueous vapour, the results obtained in all the nine experiments made by this process are as accurate as it can be expected by any method; and it can be recommended to chemists even in its simplified form, as described above.

I have also made a number of experiments with the process first proposed by F. Schulze, and modified by many subsequent chemists, viz., the reduction of nitrogen acids in an alkaline solution by means of iron or zinc (aluminium has also been used for this purpose). The total nitrogen is thereby supposed to be converted into ammonia, which is collected in hydrochloric acid of known strength, and estimated by re-titrating the same. Nearly the whole of my experiments were made according to the prescription given by Siewert (*Annalen der Chemie und Pharmacie*, vol. cxxv., p. 293): he employs an alcoholic solution of potash in order to prevent the violent bumping of aqueous solutions of caustic alkali and a mixture of zinc and iron, similar to Harcourt's process, published about the same time. From the latter I adopted the recurved gas-delivery tube and the inclined position of the reduction-flask, as a precaution against spurting over of any fixed alkali. I had, however, to use caustic soda in the place of caustic potash, as I could not procure the latter free from nitre, and it is just possible that the apparently good results obtained by this process may in some cases be due to the employment of impure potash. I for my own part—working with rigid accuracy, and, if anything, overdoing all the precautions prescribed for this process (for instance, allowing the mixture to stand some

* *Proceedings o the Newcastle Chemical Society.* Advance Sheet.

time and distilling very slowly, say three to four hours)—never obtained any satisfactory results. The ammonia produced fell short, in six experiments, from 16 to 26 per cent of that calculated from the pure potassic nitrate, &c., employed. Nor could I better the case by some experiments tried with the original plan of Schulze's, and by a modification proposed by Hager. A number of chemists have come to the same conclusion, viz., that the process of estimating nitrates by reduction in an alkaline solution cannot be depended upon; and although a number of other chemists certainly have obtained accurate results by it, this may be due partly to the fact that in some special circumstances the process does work well, whilst it does not in other cases, and partly to a compensation of the loss of ammonia by the nitre consumed in the potash employed, or by carrying over of fixed alkali. A process which gives such uncertain results, in spite of scrupulously carrying out the prescriptions given for it, ought not to be resorted to so long as any other process of undoubted accuracy is available.

II. *Estimation of Nitrous Acid.*

In this case the discrepancies among the results obtained by different chemists are still greater—probably because the methods have not been controlled in many cases by means of a substance of absolutely certain composition. As such I employed silver nitrite, obtained by mixing a hot solution of siver nitrate and of sodium nitrite; it was re-crystallised twice from boiling water, and dried *in vacuo* over sulphuric acid. Its purity was proved by igniting it.

0·4780 grm. yielded 0·3357 Ag.; theory 0·3352.
0·5057 ,, ,, 0·3532 ,, ,, 0·3546.

By means of this, several test-liquids of artificial "nitrous vitriol" were made. Each time 5 grms. of pure $AgNO_2$ were dissolved in 500 c.c. of pure concentrated sulphuric acid, of a density of 1·842 at 15° C., in such a way that the salt only came into contact with the acid at the bottom of the vessel, so that the N_2O_3 evolved was immediately dissolved by the acid, and only one or two bubbles of it escaped. The sulphuric acid employed was absolutely free from nitrogen compounds, as proved by the most delicate of all reagents—diphenylamin. The liquid obtained was perfectly clear, the silver sulphate dissolving in the strong acid.

This liquid was used for testing with potassium permanganate and potassium bichromate with urea, and the silver nitrite was tried directly by reduction in an alkaline solution (Siewert's process). It should be stated from the outset that the only really accurate method for estimating N_2O_3 was proved to be that by means of potassium permanganate (first proposed by Feldhaus); but this plan also is only perfectly accurate when used in the less convenient form of running the nitrous vitriol from a burette into a measured quantity of permanganate, so as to oxidise the N_2O_3 momentarily before it can split up into NO and NO_3H (with the water present), since a certain quantity of NO always escapes if the opposite plan be followed—that of running the permanganate into the nitrous vitriol. Only in one way the latter plan gave approximately good results; perhaps near enough for factory work, but never quite accurate, viz., if either the nitrous vitriol was used undiluted, the bulk of the permanganate necessary for its oxidaton was run upon it, the strata were allowed to mix very slowly, and ultimately permanganate added, till the pink colour remained; or, if the nitrous vitriol—say 5 or 10 c.c.—was run by means of a pipette down to the bottom of a large quantity of water—say 500 c.c.—without mixing them at first, and then permanganate was run in, so that the reaction takes place more in the lower part of the liquid. The first plan has been proposed by Mr. Crowder, the second one by Prof. Winkler (in an unpublished letter to myself). A very large number of tests were made by every one of these modifications, but there was always a certain loss of N_2O_3; and only by the process of running the nitrous vitriol into the permanganate solution, really accurate and wholly constant results were obtained. The permanganate solution was employed as a semi-normal one; that is to say, giving up 0·004 oxygen for each c.c., or indicating 0·0095 N_2O_3. It had to be diluted pretty strongly—say 1·20 water—to avoid too great a heating. When the temperature of the measure rises above 80° C. the results are no more accurate; from 30° to 40° C. is the most convenient temperature, as then there is no danger whatever of any over-heating, and at the same time the reaction takes place much more rapidly than in the cold. When ordinary nitrous vitriol, of about 1·7 sp. gr., is employed, the rise of temperature caused by its mixing with the test-solution is only slight, and it is convenient to dilute the permanganate with tepid instead of cold water, in order to hasten the reaction.

Potassium bichromate has been used for years in the Tyne district for testing nitrous vitriol, and the same has been introduced into many German works by Gerstenhöfer. It is employed precisely in the same way as the permanganate, according to that plan which I have found to be the most accurate one, viz., pouring the nitrous vitriol out of a burette into a measured quantity of potassium bichromate of known strength. Its colour thereby changes soon into brownish green, and at a certain point there is a sudden change into blue-green, which shows the end of the reaction. After some practice this point can be hit with great nicety, but there is always an uncertainty to the amount of several drops, whilst with permanganate no experienced eye is required, and it is easy to work to a single drop. Since stable test-solutions can be obtained by employing pure crystallised potassium permanganate, there is no reason left for the use of the less convenient bichromate.

Bleaching-powder has also been used for the same purpose, and it seems to work tolerably well, to judge from the experiments of Mr. Davis (Chem. News, vol. xxv., p. 124), but, as the only recommendation in its favour can be cheapness, and in every other respect it is necessarily inferior to permanganate, I have not even drawn it into the range of my experiments.

I have further tried Siewert's method (reduction by zinc and iron in an alcoholic solution of potash), but, on finding no more accurate results with silver nitrite than I had previously found with potassium nitrate, I at once abandoned this tedious and troublesome plan, which has no *locus standi* besides any of the methods mentioned hitherto.

A good deal of time was, however, spent with the urea method, which has been recommended as the most accurate test for nitrous acid—first by Peter Hart (*Muspratt's Chemistry*, ii., 1040). Mr. Hart does not appear to have tested the method by pure silver nitrite (the only reliable way), but simply to have inverted Millon's urea test, and to have assumed, from theory, that the only reaction taking place is the following:—

$$CON_2H_4 + N_2O_3 = N_4 + CO_2 + 2H_2O.$$

Nitrous vitriol is dropped into a boiling solution of nitrate of urea until a drop of the liquid shows an excess of N_2O_3 to be present by staining blue a mixture of starch and potassium iodide in solution. I cannot conceive that this method could ever have come into extended application. Even the costliness of pure nitrate of urea must have deterred most chemists—certainly nearly all factory chemists—from its use, otherwise its utter worthlessness would have been proved more universally before. Working with all precautions, I found that 1·230 grms. of nitrate of urea required in two experiments 18·0 and 17·5 c.c. of my artificial nitrous vitriol (prepared with silver nitrite), instead of 32·5 c.c., which it ought to have taken, and that up to the point when the starch and potassium iodide were stained blue instantaneously. But long before this point the colouration took place after a few seconds' contact, so that it is impossible to say with any degree of

accuracy when the end of the reaction had come. Nor can it be expected that Hart's method should give any accurate results, since Claus has proved (*Berichte der Deutschen Chemischen Gesellschaft*, iv., 140) that the reaction between urea and nitrous acid is anything but so simple as assumed by Mr. Hart, and that a considerable quantity of ammonium salts is formed thereby.

I also tried the plan proposed by Mr. Crowder (read before our Society in 1871, and further published in the Chemical News, vol. xxiv., p. 237), viz., to put a certain quantity of nitrate of urea in a Geissler's apparatus for estimating carbon dioxide, to run the nitrous vitriol into the delivery flask from the stoppered side tube, and to calculate the N_2O_3 present from the loss of weight corresponding to the N and CO_2 formed. The four following results were obtained, viz. :—

1. Employed : 26·8095 nitrous vitriol, containing 0·0359 N_2O_3; found loss of weight, 0·0463 = 0·0357 N_2O_3.
2. Employed : 25·6670 nitrous vitriol = 0·03421 N_2O_3; found loss of weight, 0·0472 = 0·03587 N_2O_3.
3. Employed : 25·2250 nitrous vitriol = 0·03361 N_2O_3; found loss of weight, 0·0490 = 0·0372 N_2O_3.
4. Employed : 26·2163 nitrous vitriol = 0·0347 N_2O_3; found loss of weight, 0·0562 = 0·0427 N_2O_3.

It will be seen that the results obtained by Mr. Crowder's process are a great deal nearer the truth than those of Hart's process, but they are still very unequal, and sometimes very inaccurate, and as the process is both costly and tedious, requiring, as it does, three accurate weighings of a heavy apparatus on a delicate balance, it cannot for a moment hold its ground beside the permanganate process, which takes a few minutes for its performance, and even in its less accurate forms, as described above, gives far better results than the urea process. Mr. Davis (Chem. News, vol. xxv., p. 124) has had similar unfavourable experience with both Hart's and Crowder's process. He likewise recommends the permanganate process, but without basing his judgment on the examination of a material of certain composition, such as silver nitrite.

III. *Estimation of Nitrous and Nitric Acid in the same Sample.*

This can be effected in the most satisfactory way by first oxidising the nitrous acid by means of standard potassium permanganate, then adding a measured volume of a solution of ferrous sulphate of known relation to the permanganate, and finishing the process as prescribed for the estimation of nitric acid. From the total quantity of nitric acid thus found a deduction is made for that corresponding to the N_2O_3, the difference corresponding to the nitric acid originally present. It is only necessary to deduct one and a half times the number of c.c. first consumed for oxidising N_2O_3 into N_2O_5, from the number afterwards found (in the shape of ferrous sulphate) consumed for reducing N_2O_5 to N_2O_2; the remainder will show how much N_2O_5 (or rather NO_3H) was present. The whole operation is carried on from beginning to end in the same flask, fitted with a Bunsen's india-rubber valve, as above described. This I proved to be altogether correct by dissolving some pure potassium nitrate in my artificial nitrous acid prepared with silver. On testing, as by the plan just described, I found—

1. Employed 0·2010 KNO_3, found 0·2012.
2. ,, 0·1950 ,, ,, 0·1936.

A third blank experiment was made with the nitrous acid without adding any potassium nitrate. Originally used 10·2 c.c. permanganate; found to require for reduction, ferrous sulphate equal to 15·15 c.c. permanganate instead of 15·3; the 0·15 c.c. of permanganate used in excess of the theoretical quantity in re-titrating the iron solution would be required for staining the large volume of liquid obtained at the end, so that the blank experiment may be declared to be quite satisfactory.

IV. *Analysis of Nitrous Vitriol from a Sulphuric Acid Works.*

It seemed to be desirable to apply the just-described process to the analysis of nitrous acid obtained on a large scale from the absorbing column of a sulphuric acid works. I procured such from a factory on the borders of the Lake of Zürich. It had a specific gravity of 1·691, and was evidently almost saturated with N_2O_3. Eleven experiments proved it to contain 4·13 grms. N_2O_3 in 100 c.c. of acid (= 2·44 per cent by weight). Now, the published analyses of nitrous vitriol generally mention the presence of NO_3H in the same as well. For instance, Winkler found 0·256 per cent, Kolb even 0·9 and 1·14 per cent, calculated as N_2O_5. It is not, on the face of it, clear how nitric acid can get into nitrous vitriol, since it cannot very well bodily traverse the chambers without being reduced to lower nitrogen oxides; and since it is not regenerated either from the latter in the presence of sulphuric acid, the oxidation in this case never going beyond N_2O_4, as proved by Winkler himself. Experiment has proved in my special case that the nitrous vitriol really contained no NO_3H whatever. The additional permanganate, over and above that corresponding to N_2O_3, amounted, in two experiments, to 0·05 and 0·1 c.c., which is just sufficient to stain the liquid; and I am inclined to believe that nitrous vitriol really does not contain any nitric acid, except perhaps traces, in any case, for I was able to show by experiment—performed purposely by the faulty method generally in use—that nitric acid was generated during the testing process where it did not exist before. My artificial nitrous acid, prepared from pure $AgNO_2$, and thus absolutely free from NO_3H, required, as mentioned above, for its reduction, after oxidation to NO_3H by means of permanganate, as nearly as possible exactly the theoretical quantity of ferrous sulphate, viz., that corresponding to one and a half times the quantity of permanganate first used. But this was only the case when the oxidation had taken place in the way described by me as the only accurate one, viz., by dropping the nitrous acid into the permanganate. When, purposely, the opposite way had been employed, viz., diluting the nitrous vitriol with very much water, then oxidising by permanganate and reducing again, the following results were obtained :—

1. Real percentage in 100 volumes of acid, 0·235 N_2O_3, 0·000 N_2O_5. Found by the above faulty method, 0·180 N_2O_3, 0·045 N_2O_5; the latter corresponding to 0·027 N_2O_3, leaves 0·028 for absolute loss (probably as NO).
2. Found 0·199 N_2O_3, 0·036 N_2O_3, the latter corresponding to 0·021 N_2O_3, leaving 0·015 for absolute loss.

It was thus positively proved that, by the more usual plan of testing nitrous vitriol, nitric acid is generated in the process of dilution, according to the equation—

$$3NOOH = 2NO + NO_2OH + H_2O.$$

ON THE PRECIPITATION OF MANGANESE BY HYDROGEN PEROXIDE.*

By G. ROSENTHAL, Ph.D.

It is a well-known fact that hydrogen peroxide and manganese peroxide decompose each other with liberation of O. This can easily be demonstrated by suspending recently precipitated MnO_2,H_2O in water and adding thereto a solution of H_2O_2. A brisk evolution of O sets in, and by the addition of a little acetic acid MnO is dissolved and may be separated by filtration, or if a sufficient quantity of H_2O_2 were used the liquid would become quite clear. If, now, in the presence of undecomposed H_2O_2 ammonia is added, the Mn goes down again as

* Partly published in *Dingler's Polyt. Journ.*, July, 1877.

hydrated peroxide. This observation led to a series of experiments with the view of estimating manganese by using H_2O_2 instead of Br or Cl. The result is that Mn can be conveniently and accurately precipitated as peroxide of ammonia after addition of a solution of H_2O_2.

As Mn is mostly associated with Fe, as in ores, slags, spiegeleisen, and ferro-manganese, I proceed to describe the mode of precipitation [illegible] the solution of the chlorides by acetate of soda. The filtrate from the iron acetate containing free acetic acid is boiled down to about 150 c.c. and allowed to cool. A solution of H_2O_2 (10 vols. commercially) is then added in the proportion of about 10 c.c. for every 0·1 or 0·15 gr. Mn in the liquid. After half an hour or an hour neutralise with a few drops of dilute ammonia, when the Mn goes down in the form of black flocculent MnO_2,H_2O, while evolution of O ensues from the action of NH_3 upon H_2O_2. Heat gently, renewing the addition of ammonia carefully until the excess of H_2O_2 is destroyed. It is thus easy to control the precipitation so that the smell of ammonia after its completion is just perceptible. When the Mn is totally precipitated it has the tendency to separate in flocks, the supernatant liquid remaining clear. This characterises the end of the precipitation as with hydrated oxide of iron thrown down by ammonia. The warming can be continued to unite the particles of the voluminous precipitate and facilitate its subsidence. It can be filtered at once, decanted with hot water, and finally washed on the filter until the Cl reaction disappears. With proper manipulation the precipitate should be black. A large excess of H_2O_2 is to be avoided; an insufficiency renders oxidation incomplete of part of the Mn remaining in solution; the portion precipitated is brown or brownish and does not settle properly; much NH_4Cl is objectionable, but a small amount is immaterial.

Where no iron is in solution with the manganese, the latter can at once be precipitated with H_2O_2 after addition of sodic acetate.

I estimated the Mn in the foregoing manner with great accuracy and rapidity. In a few cases where the necessary precautions had been omitted, a little Mn was detected in the filtrate by NH_4S, but the precipitations were absolute when I operated as described. I abstain from the quotation of the analyses made with the above-named substances and artificial mixtures of Mn with other salts, as the figures which I shall give later on will satisfy every chemist that the method is as accurate, if not more so, than any hitherto known.* I will only allude to the generally adopted bromine method.

One great advantage of the H_2O_2, and one apparent to everyone using it, is that no solids are brought into the solution with it, and that after the precipitation of Fe it is possible to work throughout with small volumes of liquid, an advantage not to be underrated in the complete analyses of ores. But as in many cases nothing more than the estimation of Fe and Mn is wanted, a comparison will be more useful in regard to other substances going down with the manganese as impurities.

Mr. Riley† has already in his recent valuable communication to the Iron and Steel Institute made some important observations as regards the presence of ZnO and BaO in manganiferous iron ores, and I can in the main confirm his results when Br is used to precipitate the Mn. I had hoped it would be possible to keep those metals in solution when using H_2O_2. Unfortunately this was not the case in my experiments. Both BaO and ZnO went down and could be discovered and estimated by separation from the Mn. As it was not in my intention to test the merits of acetates of soda and ammonia respectively for the precipitation of the iron, I have throughout used the former as being more suitable. The following figures show a few results obtained by Br and H_2O_2 respectively:—

0·6666 gr. ore gave by—

	H_2O_2. Gr.	Br. Gr.
Mn_3O_4	0·1440	0·1469
Containing BaO.. ..	0·0038	0·0048
Leaves Mn_3O_4	0·1402	0·1421
Mn [illegible]	15·5	15·35

0·7261 [illegible] gave by—

	H_2O_2. Gr.	Br. Gr.
Mn_3O_4	0·1869	0·1865
Containing ZnO	0·0158	0·0152
Leaves Mn_3O_4	0·1702	0·1716

A third cargo gave by—

	H_2O_2. Gr.
Mn_3O_4	0·2319
Containing ZnO	0·0214
Leaves Mn_3O_4	0·2205

Mn_3O_4 found in filtrate of ZnS = 0·2190.

By both methods about the same quantities of ZnO and BaO were precipitated, but the Mn_3O_4 found by Br was a little higher than that by H_2O_2. The same difference is more obvious in other cases, for instance in a sample of ferro-manganese of 45 per cent Mn. In this analysis both portions of Mn_3O_4 were re-dissolved for re-precipitation, but the reagents were reversed.

Equal vol. of solution gave—

	a. By H_2O_2.	*b*. Br.
Mn_3O_4	0·3006 gr.	0·3045 gr.

after re-dissolving—

	c. By Br.	*b*. H_2O_2.
Mn_3O_4	0·3026 gr.	0·3030 gr.

a had gained 0·0020.
b had lost 0·0015.

The two precipitates were taken and submitted to an oxidation test with iron wire and permanganate of potash:

Mn_3O_4 found = 0·6020 gr.

There is a deficiency of 0·0036 Mn_3O_4; but allowing for an error in a test where each part of Fe found represents two of Mn_3O_4, or allowing for a possible difference between the real filter ash and that assumed to be present, 0·3010 Mn_3O_4 found is nearer the original weight 0·3006 than 0·3045.

The excess weight by Br is probably alkali; therefore to ensure perfect accuracy, a second precipitation of the Mn as carbonate would seem necessary. Not so with H_2O_2.

It is true that the presence of more ammonia salts would partly eliminate the errors caused by ZnO, BaO, &c., as Mr. Riley points out; but even then a subsequent separation of ZnO will be necessary in accurate analyses, while BaO can be separated with the silica before the precipitation of the Fe, as acetates keep small quantities of $BaSO_4$ in solution. On the other hand, the results by H_2O_2 prove that those oxides will go down with the Mn, not by reason of the alkalinity of the sodic acetate, but of the great affinity of ZnO, BaO, &c. to oxide or peroxide of manganese.

As regards CaO one experiment will suffice to show that the error caused by this base is insignificant when H_2O_2 is used. A spiegeleisen slag gave—

1. Precipitation Mn = 18·23 per cent.
2. " " = 18·03 "

The difference of 0·20 per cent was CaO; NH_4Cl was present. When working slags or ores rich in CaO with Br, serious mistakes must be made in consequence of the

* Here I would remark that H_2O_2 has been proposed by Mr. Wanklyn for the detection of Mn in waters. See "Water Analysis," third edition, p. 48.

† "On the Estimation of Manganese, &c.," by E. Riley, F.C.S.

excess of NH_3 used, and of allowing the alkaline solution to stand.

In conclusion I would speak against the necessity of the second precipitation of the Fe, which has been often declared indispensable, and more recently by Riley and Shöckmann.* The latter has quoted his results in proof of it, but the quantities of Mn in the second filtrates are so variable that they cannot possibly be taken as proving an absolute necessity. While the percentages of Mn in the analysed samples of spiegeleisen vary from 9 to 11 per cent (in one case 14 per cent) the Mn found in the second filtrate varies from 0·25 to 1·04 per cent. If the same mode of operation had always been used, the relative proportions of Mn left with Fe to the total quantity in solution ought to have been at least approximately the same, provided the same quantities of substance were operated upon. I have often examined my basic acetate of iron for Mn, and have not been able to detect more than traces in the filtrate. It is not to be seen why the results should be at variance when working every time with about equal volumes of liquid of equal concentration, and at equal temperatures, and when using about the same quantities of reagents. It depends upon the manner of the precipitation. I found the best way to neutralise with carbonate of soda until the liquid just remains turbid after heating almost to boiling, and before a precipitate is produced, to add a measured volume of a 25 per cent solution of crystallised sodic acetate previously heated to boiling, and in the proportion of about 10 parts of the salt to 1 part of Fe. After this the liquid is boiled for a few minutes, and then the precipitate settles rapidly. My friend Mr. Arnold will continue these experiments.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.†

By Dr. A. W. HOFMANN.

(Continued from p. 136.)

Compounds of Nitrogen.

Ammonia and Ammoniacal Salts. By M. Seidel, Director of a Manufactory in Amsterdam.

Although in the report of the London Exhibition of 1862 it was justly asserted that the ammonia manufacture was still in the same condition as in 1851, there has been during the last ten years an essential alteration, and this branch of industry has been developed in an unexpected manner both technically and commercially.

Up to 1860 the manufacture of ammoniacal salts was trifling in proportion to the existing supply of the raw material. The price of the products was too low to stimulate an increased production, and the technical manipulations were generally of a very primitive character.

Latterly, and especially since 1870, the use of the sulphate of ammonia for agricultural purposes has increased year by year, and both the technical and the commercial evolution of the manufacture have kept pace with the growing demand.

Among the ammoniacal salts met with in commerce the sulphate has a quite preponderating importance, and is used almost exclusively in agriculture or in the manufacture of alum.

The use of caustic ammonia has also greatly increased, but, on the other hand, the consumption of sal-ammoniac, both sublimed and crystallised, has greatly fallen off, so that in many establishments the plant for this branch has been removed and replaced by apparatus for the production of the sulphate of ammonia.

The sources of ammonia have remained essentially the same.

The first rank is still occupied by the so-called ammoniacal liquor or gas-water from the gas-works, in comparison with which all the other raw materials may be said completely to vanish.

The quantity of ammoniacal salts obtained from the by-products of the prussiate of potash works, from the manufacture of animal charcoal, and from putrid urine, &c., form but a very small fraction of the total production.

Proposals for opening up new sources of ammonia have certainly not been wanting. Thus Hunt* patented in England a process for obtaining sal-ammoniac by passing a mixture of hydrochloric acid and nitrogen (or air) over ignited coke, previously saturated with ferric or manganous chloride. This is merely the resuscitation of a proposal made eighteen years ago by R. Wagner,† the only difference being that Hunt uses salts of manganese, whilst Wagner recommends a salt of magnesia. The process has not hitherto obtained industrial importance. The same may be said concerning Hutchinson's‡ process, which consists in distilling the nitrogenous residues of the starch manufacture in retorts along with lime or caustic soda. Brief mention must also be made of the method of Coste and Paupin de Rosnay§ for utilising the ammonia of canal-water.‖ The water is to be mixed with magnesia and a soluble phosphate, the precipitate of ammoniaco-phosphate of magnesia is to be collected, dried, and ignited with lime in retorts. The ammonia given off is conducted into an acid, whilst the residue is utilised as manure. In this case also the matter has not gone beyond the experimental stage.

Preparation of Ammonia from Gas-Liquor.—The ammoniacal liquor which collects partly in the condensers and partly in the washing apparatus of gas-works consists of a mixture of volatile and fixed salts of ammonia in very variable proportions. Among the former are ammonium sulphide and carbonate and free ammonia, whilst the latter consist mainly of the ammonium salts of sulphocyanogen and hyposulphurous acid, along with traces of the sulphate and chloride. The total percentage of ammoniacal compounds fluctuates greatly, but as it is to the advantage of the gas-works to absorb the ammonia as far as practicable, and as concentration of the gas-liquor increases its value, it is now generally delivered stronger than was formerly the case.

The approximate valuation of the ammoniacal liquor is effected by means of a hydrometer, but as the specific gravity of the liquor is essentially affected both by the quality of the water originally used and by the presence of foreign constituents, the hydrometric valuation is very uncertain, as will appear from the following table, in which samples of gas-liquor of equal value according to the hydrometer, but different in strength according to analysis, are grouped together.

Degrees Beaumé at 15° C.

2°	2·50°	3°	3·50°	4°	4·50°	5°	6°
1·16	1·30						
1·42	1·43						
1·50	1·63	1·63					
1·77	1·77	1·76	1·87				
	1·98	1·90	2·00				
	2·18	2·10	2·24				
	2·65	2·38	2·40	2·53			
		2·45	2·72	2·72	2·[illegible]		
				2·90	2·85		
				3·40	3·06		
					3·40		
					3·53	3·67	3·74

* Fresenius, *Zeitschrift fur Analyt. Chemie*, 1877, p. 172.

† "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

* Hunt, Chem. News, 1864, ix., 62.

† R. Wagner, *Wagner's Jahresberichte*, 1856, 83; 1857, 122.

‡ Hutchinson, Chem. News, 1864, ix., 31.

§ Coste et Paupin de Rosnay, *Ann. d. Génie Civil*, 1876, 807; *Mont. Scientifique*, 1868, 516; *Deutsche Industrie Zeitung*, 1868, 298.

‖ The water in question is probably that of Dutch canals which receive the sewage of the streets through which they pass. The same process has been patented in England for the treatment of sewage.—Ed. *C.N.*

The percentage of fixed ammonia is on the average 0·3, whether the hydrometer indicates a higher or a lower degree. The percentage of sulphur ranges from 0·33 to 0·50.

The utilisation of the liquor is generally effected by expelling the gas by distillation in iron boilers, which are heated either by direct fire or by steam, air being simultaneously forced in [J. Braby* and J. Baggs]. Certain English manufacturers make use of apparatus resembling the scrubbers at gas-works in which the gas-liquor flows down from above, whilst the steam at a high tension rises up from below—a process objectionable in so far that such establishments can either not use lime at all, or must employ it under unfavourable conditions.†

In the establishment of Messrs. Van der Elst and Matthes, of Amsterdam, the ammoniacal liquors from most of the Dutch gas-works are treated for sulphate of ammonia as follows, having been brought by water in barges specially constructed:—

The liquor is distiled in iron stills, holding from 35 to 50 hectolitres each, and heated by steam, which is furnished by five steam-boilers of 30 horse-power each. The stills are fixed at the same level, and are grouped in pairs, which can be worked alternately, being connected by reciprocating cocks.

The volatile constituents are first distilled off without the addition of lime, and then the quantity of milk of lime required for the decomposition of the fixed ammoniacal salts is driven in by steam-pressure. The products of distillation pass first into a collecting vessel, and from here through 5-inch (13-centimetre) valve-cocks into large receivers filled with sulphuric acid, in which the ammonia is absorbed without the slightest loss, since the cocks are so arranged that the products may be conducted at will into one or the other receiver.

The residual watery vapour, plentifully contaminated with sulphuretted hydrogen and carbonic acid, is removed from the receivers by a special chimney fitted with an arrangement for burning the sulphuretted hydrogen.

The escaping vapour, on its way to the chimney, traverses prolonged series of pipes, which raise the temperature of the gas-liquor about to be distilled to 50° or 60°. Besides an important economy in fuel, this arrangement produces the further advantage that the gaseous mixture deposits a great part of its watery vapour, which greatly facilitates the combustion of the sulphuretted hydrogen.

The annual production at the works of Van der Elst and Matthes amounts to about 1200 tons sulphate of ammonia.

All establishments where gas-liquor is treated in quantity are compelled to pay great attention to the pernicious emanations which are inseparably connected with this manufacture.

Unless proper precautions are taken, not alone the residents in the neighbourhood suffer from the copious development of sulphuretted hydrogen, but the men employed in the works are attacked with violent inflammation of the eyes.

The progress made in this direction consists principally in the improvement of the burners for the combustion of the noxious gas and the construction of chimneys with increased draft.

The Compagnie Parisienne d'eclairage et de chauffage par le gaz, which in its three large establishments produces yearly about 3000 tons sulphate of ammonia, and, in addition, large quantities of caustic ammonia, has described, in a special treatise,* the arrangements adopted for the sanitary improvement of its works.

As another important improvement must be mentioned the safety-valves which are now attached to every still. Although, under ordinary circumstances, these apparatus work at a very low pressure, obstructions may nevertheless be produced in the gas delivery-tubes under a variety of circumstances, and may easily occasion explosions, such as took place in 1867 at the establishments of Van der Elst and Matthes, of Amsterdam, and of Kunheim and Co., of Berlin. These dangers are, once for all, obviated by the introduction of safety-valves.

(To be continued.)

J. Braby, CHEM. NEWS, xv, 182.

† The following description of the apparatus used in the manufacture of caustic ammonia at the works of Messrs. Jaffé and Darmstädter, of Berlin, has been communicated to the editor by Dr. L. Darmstädter. It consists of three superposed boilers containing about 50 hectolitres, the two lower being heated by direct fire, and provided with agitators to ensure a perfect commixture of the lime and the gas-liquor and to prevent the lime from burning to the bottom of the boiler. The upper boiler serves as a preparatory heater, and to a certain extent as a dephlegmator. The gas from the third boiler is passed for the removal of watery vapour through an arrangement of Liebig's condensers as extended as possible and preferably to 12·5 metres in length, from which it finally escapes into the washing bottles and condensing apparatus, which are connected together by means of a tube filled with wood-charcoal for the absorption of any residual empyreumatic matter. By means of a length of this pipe and by the interposition of more washing-bottles it is possible to obtain chemically pure ammonia. In the manufacture of caustic ammonia it is of course essential to introduce into the still before the commencement of the operation the whole of the lime needful for decomposition, as otherwise the resulting product may be easily contaminated by volatile ammoniacal compounds, such as ammonium sulphide and carbonate.

* Note relative aux divers produits et aux ouvrages exposés a Vienne par la Compagnie Parisienne.

† The precipitate of sulphide of nickel dissolved in nitric acid yields no trace of cobalt, showing that the separation is perfectly complete.

SEPARATION OF NICKEL AND COBALT.

By Dr. T. L. PHIPSON.

THE separation of nickel and cobalt has hitherto been a somewhat difficult operation, but by the new method, which I made known a short time ago, this is effected easily and rapidly. The following method of detecting and isolating minute quantities of nickel in commercial chloride of cobalt, supposed to be pure, will give an idea of its practical nature:—A few grains of that salt are dissolved in water, and the whole of the cobalt precipitated, with the nickel, by xanthate of potash employed in slight excess, and previously dissolved in a little distilled water. A few drops of ammonia are then added, just sufficient to render the liquid slightly alkaline, and the dark green xanthate of cobalt is collected on a filter. The whole of the nickel is in the filtrate, and the whole of the cobalt in the filter. The nickel in the filtrate is precipitated by a few drops of sulphide of ammonium.†

Character of Xanthates.—Besides the yellow precipitate which the soluble xanthates give with salts of copper, all the insoluble xanthates, on dissolving in nitric acid, give rise to nitrous ether, which is readily recognised by its odour.

OBITUARY.

RICHARD APJOHN, M.A.

WE have, with regret, to record the death, in the thirtieth year of his age, of Richard Apjohn, M.A. Mr. Apjohn was a young chemist of great promise. In 1870 he matriculated as First Gold Medallist in Trinity College, Dublin. In 1871 he visited Germany, and studied in the laboratories of Professors Kekulé and Clausius, of Bonn. In 1872 he was elected Prælector of Chemistry in Caius College, Cambridge. In 1876 the University of Cambridge conferred on him the degree of Master of Arts. He was also a Fellow of the Chemical Societies of London and Berlin, and public analyst for Cambridge, Cambridgeshire, Huntingdonshire, and the Isle of Ely. He died at the Midland Hotel, London, after a short illness, on September 12, 1877. Amongst his contributions to science were the following:—

1. "A Refutation of an Attack by the Rev. Mr. Highton, on the Experiments and Conclusions of Joule, respecting the Mechanical Powers of Electro-magnetism, Steam, and Horses." (*Chemical News*, March 3, 1871).

2. "On the Occurrence of Vanadium and Titanium in the Trap Rocks of Different Countries." (*Chemical News*, October 18, 1872).

3. "On the Analysis of a Meteoric Stone and the Detection of Vanadium in it." (*Journal of the Chemical Society*, February, 1874).

4. Description of a Simple Method of Estimating Urea with Speed and Precision." (*Chemical News*, January 22, 1875).

ALPHONS OPPENHEIM.

On Monday the 18th inst., there died, at St. Leonard's, Alphons Oppenheim, whose chemical researches have so frequently been alluded to in our "Chemical Notices from Foreign Sources." Dr. Oppenheim had only recently been appointed Professor of Chemistry at Munster, Westphalia. He has occasionally visited St. Leonard's during the past few years for the benefit of his wife's health. His wife's illness was to him the cause of deep grief and anxiety, which increased when it became known to him that there was no hope of her recovery. She died at an early hour on Sunday, the 17th inst., and his grief became so great that in two hours afterwards he put an end to his own existence. A post-mortem examination showed that death had been caused by prussic acid. At the inquest the jury, without hesitation, returned a verdict of "Suicide while in a fit of temporary insanity."

NOTICES OF BOOKS.

Condemned Meat: a Report to the Sanitary Committee of the Honourable the Commissioners of Sewers of the City of London upon Various Methods of Dealing with Meat seized as unfit for Human Food in the City of London. By W. S. Saunders, M.D., F.S.A., Medical Officer of Health and Public Analyst for the City of London. London: Skipper and East.

To prevent the meat seized from occasioning a nuisance during its transit, the author immerses it in a solution of "Cooper's salts," copperas, and picric acid. The first-mentioned of these ingredients is a patented mixture of the chlorides of sodium, calcium, and we believe of magnesium, obtained from the waste of certain manufacturing operations, and has been used with success, in the form of an aqueous solution, for watering streets. The copperas and picric acid are added, not so much as disinfectants as to prevent the meat from being surreptitiously sold for human food. The amount of meat which requires thus to be dealt with is occasionally very great, as much as 35 tons having been seized and condemned in a single day.

For the transport of the putrid meat Dr. Saunders proposes the use of water-tight carts, made of oak with cemented joints—in fact, cisterns on wheels.

Among the various methods for the ultimate disposal of this large quantity of offensive matter the author mentions—but, to do him justice, without approval—the strange suggestion to convey down the river in barges fitted with water-tight compartments, and deposit it in the sea "beyond the reach of tidal influences." Of course such a waste of phosphoric acid and nitrogen would be grievous to chemists who know the importance of these substances in the economy of the vegetable world. But that school of sanitarians who advocate the conveyance of sewage into the sea, or into tidal rivers, may possibly contend that condemned meat should be treated in like manner. Indeed the waste of condemned carcasses would not involve the use of such costly machinery as does the squandering of the fertilising matters contained in sewage. The total weight of meat condemned in the City during the year 1876 was 238 tons 2 cwts. 2 qrs., whilst the fish seized at Billingsgate for the same year amounted to 358 tons 15 cwts., making a grand total of nearly 600 tons of animal matter, which, if judiciously treated, ought to do more than merely cover the expenses contingent on its removal. How much putrid fish, &c., is thrown upon the waste grounds in the districts governed by the "vestries" it would be impossible to calculate, but many a time and oft our "unguarded nose" is suddenly saluted by whiffs which convince us that there is "something rotten" very much nearer than "in the State of Denmark."

We congratulate the City authorities on the ability and energy which Dr. Saunders evinces in his difficult and unpleasant duties, and we wish that the same zeal were manifested in other quarters.

The Manchester and Thirlmere Scheme: An appeal to the Public on the Facts of the Case. Manchester: J. Heywood. Windermere: J. Garnett. London: Simpkin, Marshall, and Co.

We had heard, of course, of the existence of a "Manchester and Thirlmere" scheme, but, like the majority of the nation, we supposed nothing more was intended than merely to tap the lake and utilise a portion of its surplus waters for the supply of Manchester, just as was done in the case of Glasgow and Loch Katrine. Had we been aware that it was in contemplation to turn an army of contractors and "navvies" into the beautiful Vale of Wythburn, to raise the level of the lake some 35 to 40 feet by means of a formal embankment, laying its picturesque shores under water, and substituting for the old winding road "a straight road cut on a level line," we should have deemed it our duty to have already entered our protest. We agree with the author of this pamphlet that before any such scheme is sanctioned it should be proved, first, that the increased water-supply is really needed, and secondly, that such supply cannot be obtained without an outrage upon good taste. If it is now too late to preserve the Lake District in the manner of which the American Government has recently set a brilliant example, all further engineering and manufacturing operations within its limits should be absolutely prohibited.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 11, Sept. 10, 1877.

Methods for Preserving the Flesh of Fishes.—M. R. M. d'Amélio.—The fish, cut in slices for the sake of obtaining a more rapid result, is steeped in water acidified with citric acid and dried. To soften it it merely requires to be left for three or four days in water. If kept for a long time it becomes as hard as wood, and the fatty parts have an odour of tallow. As a "better process" he steeps in a mixture of silicate of potassa and glycerine, washes, and dries.

Specific Heat and Melting-Point of Platinum.—M. J. Violle.—The mean specific heat between 0° and 1177° is 0·0388. The melting-point is probably a little below 1779°.

Note on Specific Inductive Power.—M. V. Meyreneuf.—The author has endeavoured to find what modifica-

tion in the energy of the spark is produced by a change in the nature of the insulating plate of a condenser.

On Nitroso-guanidin.—M. Jousselin.—This compound is formed from guanidin by replacing H by NO, a result obtained by dissolving the nitrate of guanidin in fuming nitric acid, and passing through the solution a current of nitrous acid, and pouring the mixture, after twenty-four hours, into excess of cold water, when there is produced an abundant precipitate of felted crystals resembling amianthus. The new compound is represented by the formula CH_4N_4O.

Moniteur Scientifique Quesneville.
August, 1877.

Phylloxera, and the means proper for Neutralising its Action on the Vine.—M. Charles Blondeau.—A long account of the various methods adopted for the destruction of this enemy of the vineyards.

New Applications of the Sulphide of Carbon.—F. Rohart.—A method for disengaging the bisulphide of carbon in the state of vapour. The author maintains that several millions of vines have been freed from the Phylloxera by his process.

Discussion between MM. Wurtz, Sainte-Claire Deville, and Berthelot.—A continuation of the well-known discussion before the Academy of Sciences.

Contribution to the Knowledge of Veratrin.—MM. Ernst Schmidt and R. Kœppen.—Taken from *Liebig's Annalen* for Feb. 17, 1877.

Studies on Salicylic Acid and the Salicylates; Treatment of Acute and Chronic Rheumatism, of Gout, and various Affections of the Sensitive Nervous System with the Salicylates.—Prof. Germ. Sée.—A medical paper.

Chrysolin, a new Yellow Dye derived from Resorcin.—F. Reverdin.—Already inserted.

Correction of the Errors due to the Variations of Temperature in Reading Hydrometers.—P. Casamajor.—A tabulated set of corrections for Balling's hydrometer, arranged for weak saccharine solutions.

A new Burette.—P. Casamajor.—A modification of the Binks burette, the exact structure of which cannot be made intelligible without the accompanying diagrams.

The American Journal of Science and Arts.
No. 77, May, 1877.

On Vortex Rings in Liquids.—J. Trowbridge.—The author finds that the formation of liquid rings is a necessary result of the fundamental equations of strains and those of hydrodynamics; and that they constitute not a special but a general phenomenon. A drop of water falling into water from a suitable height must assume the ring shape. Vortices can and do arise in certain processes of diffusion.

An Account of Discoveries of the Rev. Augustus Wing in the Geology of Vermont. J. D. Dana.—The first part of a report describing the main geological features of the region studied by the late Mr. Wing. This indefatigable observer in his hours of leisure is declared to have done more towards elucidating the age of the Vermont rocks than had been effected by the State Geological Survey.

Note on the History of Helianthus Tuberosus, the so-called Jerusalem Artichoke.—J. H. Trumbull and Asa Gray.—That this plant has no connection with Jerusalem every botanist is of course aware. Its origin has been disputed, some assigning it to Brazil, others to Peru and Mexico, and others, again, to Canada. It appears to be a native of the United States from New England to Kentucky, and to be identical with *H. doronicoides*.

Examination of American Minerals.—No. 6. Columbic Acid Minerals.—G. Lawrence Smith.—The author maintains that the metal known in England and on the Continent as niobium should be called columbium, the name by which it is designated in America. The confusion is said to have originated as follows:—"Ekeberg discovered, in 1802, a supposed new metal, which he called tantalum, but which a short time afterwards was regarded as identical with columbium; and for forty-five years tantalum and columbium were synonymous terms in all works on chemistry, although Wollaston suspected their dissimilarity. Secondly, when H. Rose made his well-known exhaustive researches on the columbite of Bodenmais, he showed that this mineral contained, not one, but two metallic acids. One of these was *tantalum*, and the other he supposed to be a new metal, which he named *niobium*. Subsequent examination, however, convinced Rose that the two metallic acids obtained from the Bodenmais columbite were really the original columbic acid of Hatchett, discovered in 1801, and the tantalic acid discovered by Ekeberg in 1802." The former body, therefore, should have retained its original name. The remainder of the paper is devoted to the examination of the columbic minerals, columbite, microlite, pyrochlore, hatchettalite, samarskite, yttrotantalite, euxenite, Fergusonite, and Rogersite.

Sensitiveness to Light of various Salts of Silver.—Carey Lea.—An examination of the power of various salts of silver to produce latent images, capable of development by the action of pyrogallol and ammonia.

Beiblätter zu den Annalen der Physik und Chemie,
No. 1, 1877, Band 1, No. 2.

Magnetism of Soft Iron Cylinders and of several Hard kinds of Steel.—Dr. Christoph Ruths.—Not adapted for abstraction.

Recent Experiments with the Radiometer, and their Explanation.—An abstract of some of the more recent papers of Mr. Crookes, as also of the researches of MM. Alvergniat, Govi, Ducretet, Gaiffe, Salet, de Fonvielle, Jeannel, Schuster, &c.

The Spectrum of Indium.—W. Claydon and Ch. T. Heywon.—Taken from the *Phil. Mag.*, ii., p. 387.

The Theory of the Reflection and Refraction of Light.—A. Lorentz. (Inaugural Dissertation). Arnheim: Van der Sande.—The author considers that Maxwell's theory of light essentially explains the phenomena, in so far as they have been examined.

Photometric Measurements in the Different Parts of the Spectrum.—R. Trannin.—The author has invented a new method for comparing the intensities of different rays of light of the same length of undulation. The rays emanating from two sources of light, A and B, are thrown upon the slit of the collimator of a spectrum apparatus by two small totally-reflecting prisms in such a manner that the rays from A illuminate the upper part, and those from B the lower part of the slit. Two superimposed spectra, *a* and *b*, corresponding to A and B, are then seen through the telescope of the apparatus. With this arrangement the comparison of the brightness of the lights is somewhat doubtful. Trannin therefore interposes between the collimator telescope and the dispersing prism a Foucault's prism, a plate of quartz cut parallel with its principal axis, and a Wollaston prism. (*Journ. der Physik*, v., p. 297.)

Determination of the Depth of the Sea, by means of the Bathometer, without the use of the Lead.—C. W. Siemens.—From the *Comptes Rendus*, lxxxiii., p. 780.

Variations in the Critical Point of Carbonic Acid in Minerals, and Conclusions from these and other Facts.—W. N. Hartley.—From *Nature*, xv., p. 167.

The Absorptive Power of Bodies for Heat.—M. Aymonnet. From *Comptes Rendus*, lxxxiii., 971.

New Mode of Examining Thermic Spectra.—M. Aymonnet.—From *Comptes Rendus*, lxxxiii., 1102.

The Rotation of the Plane of Polarisation by Quartz.—MM. J. L. Soret and E. Sarasin.—From *Comptes Rendus*, lxxxiii., 818.

Investigations on the Coefficients of Transpiration.—A. Guébhard.—From *Comptes Rendus*, lxxxiii., 1241.

The Atomic Weight and Specific Heat of Glucinum (Beryllium).—J. Emerson Reynolds.—From the *Phil. Mag.*, iii., 38.

Ludlamite, a new Mineral from Cornwall.—F. Field.—From the *Phil. Mag.*, iii., 52.

The Rotary Power of Styrolen.—M. Berthelot.—The author, in opposition to the theoretical views of Van't Hoff, which the latter considered to be verified by experiments performed with a material not quite pure, has again determined the rotation of the plane of polarisation of styrolen. In two samples the rotatory power for the sodium line amounted to $-3°1'$ and $-3°4'$.—*Ann. der Chemie*, ix., p. 53.

Influence of Temperature upon Magnetisation.—J. M. Gaugain.—From *Comptes Rendus*, lxxxii., 1422, and lxxxiii., 661.

Measurements of Resistance by means of the Capillary Electrometer.—G. Lippmann.—*Comptes Rendus*, lxxxiii., 192.

Electro-conduction and Electrolysis of Compounds. Action of the Current of a Battery of 8040 Elements upon Imperfect Liquid Conductors.—L. Bleekrode and Warren de la Rue.—From the *Proceedings of the Royal Society*, xxv., 322.

An Experiment analogous to the Sonorous Flames.—M. Montenat.—From *Comptes Rendus*, lxxxiv., 33.

A new Direct-vision Spectroscope.—H. Schellen.—An account of Hillger's instrument.

Determination of the Poles of Magnets.—R. Benoit.—*Comptes Rendus*, lxxxiv., 76.

Action of Heat upon Closed Circuits containing an Electrolyte.—M. du Moncel.—*ComptesRendus*, lxxxiv., p. 83.

Bulletin de la Societe Chimique de Paris, No. 3, Aug. 5, 1877.

Action of Bromine upon Ordinary Pyro-tartaric Acid.—M. E. Bourgoin.—Already noticed.

On Two New Sulph-ureas with Acid Radicals.—M. P. Miquel.—The two new compounds are acetyl naphthyl-sulph-urea, formed by the reaction of naphthylamin dissolved in anhydrous ether with sulphocyanide of acetyl and acetyl-para-cresyl-sulph-urea, which is formed by an analogous reaction, crystallised toluidin being substituted for naphthylamin.

Preparation of the Sulphocyanate of Silicium.—M. P. Miquel.—The author has previously obtained sulphocyanate of silicium by distilling the product resulting from the action of silicic chloride upon dry finely powdered sulphocyanate of lead. He finds it preferable to place the vessel in which the reaction has been accomplished in a paraffin bath heated to 140°. A layer of sulphocyanate of silicium forms on the surface, whilst lead chloride and other solid matters collect at the bottom. After about a quarter of an hour the vessel is sealed and allowed to cool. The liquid layer soon solidifies as a beautiful crystalline mass which is easily separated. The melting-point of silicic sulphocyanate is about 137°.

Action of Heat upon Cyanamid, Dicyano-diamid, and Melamin.—M. E. Drechsel.—If cyanamid is heated until decrepitation begins, and the fire is then withdrawn ammonia is evolved, a little cyanamid is condensed in the colder parts of the tube, whilst in the warmer part there is formed a liquid ring of dicyano-diamid which rapidly crystallises. A little melamin is obtained as a residue. Dicyano-diamid melts when heated, gives off ammonia, yields a sublimate of almost pure melamin, and leaves a yellow residue. Melamin kept below its point of fusion decrepitates, and gives off white fumes, which condense as a sublimate of unchanged melamin. If melted it climbs up the sides of the tube, and is decomposed as Liebig has shown. Melamin dissolves in alcohol in appreciable quantities, and crystallises out on cooling. It dissolves also in hot glycerin. The sulphate of melamin crystallises sometimes with $1\frac{1}{2}H_2O$, and sometimes with $2H_2O$. The author has not been able to trace the circumstances which lead to the formation of one or the other of these salts.—*Journal für Praktische Chemie*, xiii., 330.

Action of Chloride of Benzoyl upon Cyanamid and Sodium-Cyanamid.—M. G. Gerlich.—This paper, taken from the *Journal für Praktische Chemie*, cannot be usefully condensed into the space at our disposal.

On Isomalic Acid.—M. M. Schmoeger.—The author obtains this acid by treating mono-bromo-isosuccinic acid with silver oxide. The acid isomalate of calcium forms a vitreous mass; the neutral lead salt is an amorphous precipitate.—*Journal für Praktische Chemie*, xiv., 77.

Synthesis of Polybasic Acids by means of Salicylic and Carbonic Acids.—M. H. Ost.—This paper, taken from the *Journal für Praktische Chemie*, xiv., 93, does not admit of useful abstraction.

On Phlorizin and Phloretin.—M. J. Loewe.—The author finds that phlorizin contains C = 52·38 and H = 5·74, corresponding to the formula $C_{23}H_{30}O_{14}$. Phloretin contains C = 64·36 and H = 4·54, a composition agreeing with the formula $C_{17}H_{14}O_6$.—*Zeitschrift für Anal. Chemie.*

Method for the Volumetric Determination of Zinc.—M. C. Fahlberg.—The author proposes to titrate zinc in a hydrochloric solution with ferrocyanide of potassium, and uses as indicator a solution of uranic nitrate, which, as soon as an excess of ferrocyanide appears in the solution, gives a brown precipitate, or at least a brown colouration. Manganese and alumina do not interfere. After dissolving the ore in aqua-regia, all metals precipitable by sulphuretted hydrogen, and also iron, are removed by the ordinary methods. The ammoniacal solution containing the zinc is neutralised with hydrochloric acid, and then acidulated with 10 to 15 c.c. of the same acid at sp. gr. 1·12. This solution is titrated with a solution of ferrocyanide of which 1 c.c. represents 0·01 grm. of zinc; the final reaction is performed on a porcelain plate upon which a series of drops of a solution of uranium nitrate have been placed. The results are exact to 0·2 or 0·3 per cent.—*Zeitschrift für Anal. Chemie*, xiii., 379.

Attack of Chrome Iron.—M. R. Kayser.—The author proposes to attack this ore with a mixture of 2 parts of carbonate of soda and 1 part pure hydrate of lime. The mixture is maintained for half an hour at bright redness in an open crucible with frequent stirring. The chromate formed may be easily extracted in boiling water.—*Zeitschrift für Anal. Chemie*, xv. 187.

New Method of Determining Phosphorus, Arsenic, Sulphur, Chlorine, Bromine, and Iodine in Organic Bodies.—M. G. Brugelmann.

Determination of Sulphur in Coal Gas.—These two papers are reserved for insertion in full.

Extraction of a Red Colouring Liquid from the Marc of Grapes.—A. Carpené.—The author operates upon the mass left on the distillation of alcohol from spent grapes. The colour resembles ammoniacal cochineal, and being soluble in dilute alcohol may be used for colouring wines.

Nos. 4 and 5, Sept. 5, 1877.

On a New Acid Product contained in the Leaves of Certain Vegetables.—M. Ch. Bougarel.—The acid

in question was found in the leaves of certain rosaceous plants and of the common laurel. Irs composition is :—Carbon, 69·08; hydrogen, 10·36; oxygen, 20·55; total, 99·99—corresponding to the formula $C_{72}H_{104}O_{16}$. The author names it provisionally phyllic acid, and is engaged with the preparation and analysis of its salts.

Contribution to the History of the so-called Catalytic Action of Platinum.—M. E. von Meyer.—The author concludes from his experiments that De la Rive's theory of the action of platinum upon mixtures of oxygen and of combustible gases is inadmissible.—*Journal für Praktische Chemie*, xiv. 124.

Influence of Pressure upon the Phenomena of Combustion.—M. V. Wartha.—The author has burnt stearine candles in the air at an ordinary presure and at a pressure of 1·95 atmospheres in a large iron chest, determining in each case the quantity of matter burnt per hour. Those burning at the common pressure had a flame 4·5 to 6 centimetres in height, and consumed hourly from 9·34 to 10·70 grms. of stearic acid. At the increased pressure the flame was very sooty, of a yellowish-red, and from 9 to 12 centimetres in height, but the quantity of stearic acid consumed was only 7·99 to 9·11 grms. He burnt also candles at very low pressures, as, *e.g.*, 9 centimetres of mercury. The flame was much increased, lost its brightness, and took a greenish-blue colour. Three portions could be plainly distinguished; the central part of a greenish-blue, quite detached from the wick, and having the form of a cap; this part is enveloped in a violet mantle, and this again in a second violet mantle so pale as to be scarcely visible.—*Journal für Praktische Chemie*, xiv., 84.

Capacity of Saturation of Manganous Acid.—M. Al. Gorgen.—The author concludes that the acid is bibasic (or, if atomic weights are used instead of equivalents, tetrabasic).—*Répertoire de Chemie Pure*, iv., 415.

University of Durham College of Physical SCIENCE, Newcastle-on-Tyne.

Seventh Session.

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Professor HUXLEY, LL.D., F.R.S., will commence a Course of Eighty Lectures on BIOLOGY or NATURAL HISTORY (including PALÆONTOLOGY) on Monday next, the 1st of October, at 10 o'clock, to be continued at the same hour on every week day but Saturday. Fee for the Course, £4. For the Laboratory Practice, £6.

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THE CHEMICAL NEWS.

Vol. XXXVI. No. 932.

PROPOSED TESTS FOR CARBOLIC AND NITRIC ACIDS.

By DAVID LINDO.

If 30 drops of a cooled mixture composed of 2 parts concentrated sulphuric acid, and one of water by measure, are added to 8 or 10 drops of an aqueous solution of carbolic acid (say 15 grains to an ounce of water) contained in a small porcelain dish, no colour is observed; but on adding 1 or 2 drops of nitric acid, a deep brown colour is immediately developed, which on agitating the vessel, quickly changes to a beautiful red.

I am not aware that this reaction has been noticed before, and would propose it as a test for carbolic acid.

With certain nitrates in solution, the reaction is far more sensitive than with nitric acid. The solutions should not be too strong.

It is advisable to dilute the sulphuric acid as above in testing with nitric acid, as the colours are produced with more certainty than when concentrated sulphuric acid is employed, but the latter should be used when testing with nitrates.

With 8 or 10 drops of carbolic solution, 5 grains to an ounce of water, a very beautiful reaction is obtained with a drop or two of nitric acid.

With 8 or 10 drops of carbolic solution, 2 grains to the ounce, the colours are easily produced with 2 or 3 drops of solution of nitrate of silver or proto-nitrate of mercury, not too strong.

With a little care the reactions can be obtained with one drop of these carbolic solutions.

Nitrate of silver and proto-nitrate of mercury with careful manipulation can be made to reveal the presence of carbolic acid in a solution of 1 grain in 10 ounces of water; but of this dilute solution at least 30 drops must be used, mixed with about 90 drops of concentrated sulphuric acid. After adding the test fluid, the dish should be left at rest for a little, and then gently shaken. The brown colour is rarely observed with these weak solutions.

In testing solutions of ordinary strength, place 8 or 10 drops in a small porcelain dish, and add about 30 drops of concentrated sulphuric acid if you are going to test with a nitrate. Move the vessel about to mix its contents, and allow 2 or 3 drops of the test fluid to flow down the side of the dish into the hot mixture. On giving the vessel a rotatory motion, the final colour is soon obtained, which with most nitrates is a deep magenta, of great purity and beauty if the carbolic solution was tolerably strong, and the sulphuric acid employed colourless. If the colour is not very full at first, a little more of the carbolic solution will bring it up.

With weak carbolic solutions, the final, and sometimes the only colour observed, is purple or pink.

Proto-nitrate of mercury gives a very bright yellow at first, changing to brown, and then to red, which makes it an excellent test. This yellow colour is a highly sensitive reaction, and can be plainly seen with carbolic solutions so weak that the final pink is barely or no longer discernible.

The carbolic acid used in these experiments was Calvert's No. 1, and the solutions fresh. The sulphuric acid employed was colourless.

These reactions naturally suggest the use of a mixture of carbolic and sulphuric acids as a test for nitric acid. A carbolic solution, 5 grains to an ounce of water, answers well for the purpose, and may be taken as a standard solution in testing for nitric acid in the nitrates. It should be used pretty fresh; the more so the better for all except highly dilute solutions of nitrates.

Very much stronger carbolic solutions will often fail to give the reaction if the solution of nitrates is highly dilute.

When the solution is going to be used, 8 or 10 drops are placed in a small porcelain basin, and mixed with 30 drops of concentrated sulphuric acid; 2 or 3 drops of the fluid to be tested are then added to the hot mixture.

The following solutions of nitrate of potash were tested by this method:—

1 grain of nitre in 1 ounce of water—reaction excellent.
1 grain of nitre in 2 ounces of water—reaction very good.
1 grain of nitre in 4 ounces of water—reaction still good.
1 grain of nitre in 6 ounces of water—reaction uncertain.

Sometimes a convenient way of applying the test is to dissolve the suspected nitrate in the carbolic solution, and then add sulphuric acid.

I have not found this reaction produced by any other substance but nitric acid, and trust it may prove a useful addition to our tests for this acid.

The subject seems worthy of further investigation, and as yet I have not had time for this. I shall be glad if it proves sufficiently interesting to induce others to follow it up.

Falmouth, Jamaica, September 3, 1877.

ON THE SPECTRUM OF THE METAL DAVYUM.

By SERGIUS KERN, St. Petersburg.

The author has examined the spectrum given by davyum. The metal, in powder, was placed between the carbon points of an electric lamp. The spectroscope in the hands of the author was not powerful enough to show distinctly the secondary lines, but the principal lines were seen very well.

The following are the lines of davyum seen well in the instrument:—

Fraunhofer's Lines.			
A.	17·3	F.	90·0
a.	22·0		92·0
	24·3 Da		92·5
B.	28·0		93·3 D.
	31·0 Da		93·6
	32·5		116·5
C.	34·0		122·0
	36·6	G.	127·5
	37·3 Da		135·3
	40·0		150·0
D.	50·0		157·0 Da
	53·0		157·5
	54·5 Da		160·3
	55·3	H.	162·0
E.	71·0	H_1.	166·0
b.	75·4		
	84·0 Da		
	84·8		

It must be mentioned that further researches on davyum will be made when a sufficient quantity of the metal is extracted.

Obouchoff Steel Works.

ON THE UNIFORMITY OF THE PRECIPITATE IN WHICH DAVYUM WAS FOUND.

By SERGIUS KERN, St. Petersburg.

The precipitate in which a new metal was supposed to exist, and which was obtained by the action of ammonium chloride and nitrate (Chem. News, vol. xxxvi., p. 4),

was reduced, as has been already mentioned, to metallic state by ignition. The resulting grey powder, in order to ascertain that a new metal indeed was obtained, has been submitted to the following tests:—

1. Potassium hydroxide in a davyum chloride solution produces a precipitate of a light yellow colour, insoluble in an excess of the reagent, and easily soluble in acids, even in acetic acid. Alcohol has no action on davyum solutions.
2. Potassium nitrite (KNO_2), warm, gives no precipitate; in the cold, a light silky red-brownish precipitate. The precipitate on being dried is not crystalline, but has an amorphous structure.
3. The reaction with potassium sulphocyanide belongs to davyum, as pure ruthenium gives no reaction of such kind. Prof. Bunsen ascribes this reaction to ruthenium, when it is due only to the impurity of the latter metal (N. Menchoutkine, "Analytical Chemistry," p. 211). There was no uranium or iron present.

These reactions are the most characteristic of the metal davyum.

Obouchoff Steel Works.

ON

XANTHATE OF POTASSIUM

EMPLOYED FOR THE DETERMINATION OF

SULPHIDE OF CARBON, SALTS OF COPPER AND CAUSTIC ALKALIES,

EVEN IN

PRESENCE OF ALKALINE CARBONATES AND SULPHURETTED COMPOUNDS.

By M. E. A. GRETE.

M. Vogel has already recommended the reaction of the xanthates on salts of copper for the qualitative detection of the sulphide of carbon in gas. This reaction may also serve for its determination. For this purpose we transform the sulphide of carbon into xanthate of potassium, which we titrate by the aid of a normal solution of sulphate of copper at one-fiftieth, containing, consequently, 0·0012672 grm. of copper per cubic centimetre, which corresponds to 0·006404 grm. xanthate of potassium and to 0·00304 CS_2. We may also employ the normal liquid at the twentieth, 1 c.c. = 0·003168 grm. Cu. To obtain this liquid we weigh out 3·168 grms. sulphate of copper, dissolve it in water, and add salt of Seignette and carbonate of soda until the precipitate is re-dissolved, and dilute then to 1 litre. The presence of ammonia and of caustic alkalies must be avoided. The precipitate of xanthate of copper is deposited very easily by agitation, and the end of the reaction is known by the absence of turbidity when we add a further drop of cupric liquid. Xanthate of potassium containing an excess of caustic alkali: we must saturate this with cream of tartar or, better still, bicarbonate of soda.

Determination of Copper. Inversely, the xanthate of potassium may serve for determining copper. To this end we dissolve a known weight of the salt of copper to be analysed in a mixture of salt of Seignette and carbonate of soda, then we drop in a standard solution of xanthate of potassium, of which we must verify each time the strength with the standard solution of copper. The results are very exact.

Determination of Caustic Alkalies.—As each atom of copper precipitated in the state of xanthate sets free 2 molecules of caustic alkali, the process above permits the evaluation of the latter, even in presence of carbonates and of sulphides. The substance to be analysed, as dehydrated as possible, being dissolved in absolute alcohol, we heat it with sulphide of carbon; the caustic alkali alone transforms instantaneously this latter into xanthate. The alkaline sulphides act the same. To account for this, we precipitate at first with the copper liquid until the precipitation of the sulphide and of the sulpho-carbonate, the conclusion of which is perceived by the use of a lead-paper. We complete then the titration, and each atom of copper precipitated indicates the presence of 2KHO or K_2O in the analysis.—*Chemisches Centralblatt*, ix., 921.

PYRO-CHEMICAL ESSAYS.*

By Lieut.-Col. W. A. ROSS, late R.A.

II. *Agalmatolite.*

(1.) *Appearance;* yellowish white, waxy.

(2.) Quite soft in crushing, and stuck to the polished agate. This is a peculiarity of greasy-feeling minerals, such as *soapstone*, *steatite*, *sepiolite*, &c., and is a sure indication of combined or chemical water and of silica.

(3.) Heated on aluminium plate, a fragment became white and chalky on the surface, and became blue after heating with a drop of cobalt solution.

(4.) A fragment held above the base of the gas pyrocone did not change its blue colour, but at the point gave out a slight violet pyrochrome,† showing a small quantity of potash.

(5.) In a boric acid bead, B.B., the fine powder showed only rounded white fragments like those of pure alumina; the green boric acid pyrochrome being unchanged shows that if there is any soda present it must be under 1 per cent.

(6.) In a bead composed of equal parts of boric and phosphoric acids, B.B., by the fine powder white opaque fragments were still shown, but rather more pointed than before.

(7.) In a bead of phosphoric acid, B.B., the fine powder still showed white fragments, which, however, became much reduced in size and more crystalline in appearance, like pieces of loaf-sugar. The bead itself beame gelatinous and reddish.

(8.) Boiled bead (7) in a Berlin capsule; an unclear or milky solution (*a*) and a white residue (*b*). Allowed to stand till clear, and decanted (*a*), at first gave no precipitate with sodium carbonate or hydrate solution, but as this reagent re-dissolves its aluminous precipitate (Fresenius), and the liquid was found by test-paper to be strongly alkaline, it was acidulated with phosphoric acid, when a drop of sodium carbonate gave a white flocculent precipitate.

Collection of Evidence.

Here, although the operations (1) to (5) showed that we had an alkaline aluminium silicate as in the case of *adularia*, the boric acid test (5) gave quite a different reaction, and at this stage the operator might have reasonably concluded, except from (2), that he had only alumina with a small quantity of potash present, but as that would be rapidly dissolved in phosphoric acid, he saw from (7) that the mineral is an aluminium silicate with combined water; from (4) that it contains no lime; and from (6) that there is probably no iron. The milky solution (8) was probably due to suspended silica.

III. *Albite.*

(1.) Fine powder in a boric acid bead, B.B., gave an icy mass; an alkaline silicate without water.

(2.) Added phosphoric acid to bead (1) until the ensuing opalescence became clear, in order to save the time of making a fresh bead, when I found that the siliceous mass

* It is scarcely necessary to state that these examinations are entirely qualitative.

† *I.e.*, coloured flame.

was completely dissolved. On adding B.B. fresh *albite* powder a bluish transparent mass appeared, which gradually became quite transparent at the point of the "flame" as the alumina dissolved.

(3.) Boiled bead (2) in a Berlin capsule, when the solution (which was slightly milky at first) gave with sodium carbonate a slight, white, slowly-settling precipitate. The residue gave a transparent mass in boro-phosphoric acid, with some brownish specks; probably a minute trace of iron.

(4.) A fragment held at its base tinged a blue gas pyrocone slightly violet; trace of potash; at its point strongly orange; soda; free soda.

Collection of Evidence.

An alkaline silicate of aluminium, with no lime, containing soda with a trace of potash.

IV. *Almandine.*

Appearance.—Transparent, brownish red, violetish red by transmitted light.

(1.) Crushed in (*a*) forceps (rather easily; hardness not greater than quartz), and then between agates, the fine powder was of a reddish colour.

(2.) The fine powder in a bead of boric acid, B.B., afforded (*a*) a number of white opaque balls like snowballs; magnesia. (*b*) One black ball covered with creamy matter; due to some ball-forming metallic oxide, as iron, manganese, cobalt, or copper. (*c*) A large quantity of creamy yellowish white matter diffused through the bead: both silica and alumina behave in this way when decomposed, B.B., by lime or magnesia.

Collection of Evidence.

We see by operation (2) that this mineral is not the *almandine garnet*, which I had at first supposed it to be by a reference to Bristow, "Glossary" Art. "Almandine," but the *almandine* variety of *spinel*. The black ball, therefore, was probably iron sesquioxide, and the object now was to determine this question, and if the streaky or creamy matter was due to alumina.

(3.) Added crystals of phosphoric acid, B.B., to (2) bead until the opalescence which they created had been redissolved to a clear bead; the balls and all contained matter was dissolved, and the bead became transparent, but bright yellow hot, colourless cold. This is the reaction of a small quantity of iron.

(4.) Trace of almandine to (3) bead B.B. Effervescence (?), minute brownish black balls covered with streaky white matter. After strong heating the balls were dissolved, the bead remaining transparent, but gelatinous and yellowish.

(5.) Added a third trace of *almandine* to (4) bead B.B. A number of brownish black fragments; no balls; bead nearly opaque, and yellowish white with streaky matter.

(6.) Crushed (5) bead in (*a*) forceps, and boiled the powder in a Berlin capsule. (*a*) Clear solution. (*b*) Greenish white residue.

(7.) (*a*) Afforded with a drop of sodium hydrate solution a precipitate which re-dissolved, but on rendering the fluid neutral with a few crystals of boric acid a white flocculent precipitate; aluminium hydrate? (*b*) Gave in a bead of boric acid, B.B., olive green balls with a slight white matter clinging round them.

(8.) In a bead of boro-phosphoric acid fresh *almandine* powder gave several minute brownish black balls covered with streaky white matter, which were not dissolved by strong heating like those of (4)

(9.) In a bead of boric acid, B.B., fresh *almandine* powder gave, as before, white streaky matter, white opaque balls, and brownish black balls covered with white matter, which last were extracted by boiling, crushed, and the powder treated B.B. in a fresh bead of boric acid, when black balls appeared without white matter round them, and, in addition, white opaque balls like those formed by magnesia.

Collection of Evidence.

We have now clear proof that the mineral consists of alumina, magnesia, oxide of iron, and—apparently from the green matter seen in (6) and (7)—chromium sesquioxide.

(To be continued.)

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

No. VI.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(1.) *Experiments on the Direct Reduction of Silver from its Sulphide by Mercury in the Amalgamation Process.* By R. SEGURA, of the City of Mexico.

It is remarkable that there still exists so much uncertainty as to the theory of the amalgamation process for the reduction of silver ores, while the process itself is practised on so great a scale, and has in one form been in use for more than three hundred years. Especially does doubt hang over the question of the purpose served by the "chemicals" added to the ore, water, and mercury—such as common salt, sulphate of copper, roasted copper pyrites, &c.—and by the iron of the pans in which the process is carried out in Nevada and elsewhere. These additions are made in the most varied way as to materials and quantities, some managers ascribing an almost magical importance to them, while others reduce their amount to almost nothing or discard them altogether. As the ores worked are themselves of varied character, and the work is frequently unchecked by assay, it is not easy to obtain direct evidence of the value of the practice in use at any particular set of works. Where mercury alone has been used, the upholders of the value of chemicals claim that the amalgam only contains such silver as existed in the metallic state, or as chloride or bromide, in the ore, while sulphides are supposed to be left undecomposed and lost in the tailings. In various books it is directly stated—as, for instance, in the article on the extraction of silver in "Watts's Dictionary of Chemistry" (vol. v., p. 281), that silver sulphide is not acted on by mercury.

This one point being obviously easy to settle by direct experiment, Senor Segura undertook to test it. He unfortunately lost the larger portion of his notes before transcribing them, and was therefore only able to reproduce the main results. As it seemed likely that much would depend upon the state of sub-division of the silver sulphide, it was used in three different forms—viz., in the finely pulverulent condition, as thrown down by hydro-sulphuric acid from a solution of the nitrate; massive, as obtained by fusing the precipitated and dried sulphide; and as native argentite (from Freiburg, in Saxony).

A. 1 part precipitated silver sulphide, 10 parts pure mercury, and 5 parts water, were triturated together in a porcelain mortar for two hours. At the end of that time one-fifth to one-third of the whole quantity of silver present was found in the state of amalgam, and a corresponding amount of mercuric sulphide had been formed. When the grinding was continued for six hours the same change had gone further, but the precise figures obtained have been lost.

B. 1 part of artificial fused silver sulphide, 10 parts mercury, 5 to 10 parts water, and about 20 parts of siliceous sand (to aid in pulverising the sectile sulphide) were triturated as above. It seemed that grinding for something like two hours was necessary to reduce the sulphide to so fine a state of division that the mercury readily

attacked it, but on continuing the grinding further the silver amalgam and mercuric sulphide formed as in (A).

C. 1 part native argentite, 10 parts mercury, 5 to 10 parts water, and about 20 parts of quartz sand, gave essentially the same result as in (B).

In order to see whether finely-divided metallic iron would aid in reducing the silver, some experiments were also made with addition of the "iron reduced by hydrogen" of medical use.

D. 1 part of precipitated silver sulphide, 10 parts mercury, 5 to 10 parts water, and 1 part of Quevenne's iron, were ground together. The result was as in (A), no advantage seeming to be gained by the addition of the iron, nor was there any change when it was used in much larger proportion. This result, of course, does not touch the question of the value of iron when common salt and cupric sulphate are also used.

In all these experiments the amalgamation was found to occur much more readily with a small than a large quantity of water, so that the consistence of the mass was that of a soft paste, but not thoroughly liquid—a point which may, perhaps, be worth notice in operations upon the large scale, though the question of increased power required for grinding would have also to be considered. In one or two experiments the mercury would not run together well, and could not be directly recovered by simple washing, but it was easy to separate and determine the metallic silver and mercury by dilute nitric acid, which left the mercuric sulphide unattacked.

(2.) *Experiment as to the Solubility, or Very Long Continued Suspension, of Mercury in Water.* By R. SEGURA.

That very large quantities of mercury, as well as of the precious metals, are annually lost at amalgamation works is well known. In the Spanish-American process, common salt being used, and silver chloride supposed to be formed and reduced to the metallic state by mercury, this latter metal is assumed to be washed away as calomel with the earthy portions of the slime. The experiments just recorded show that it may also be carried off as sulphide. But there is good reason for supposing that a further portion is swept away as metallic mercury in globules so minute as to remain suspended for a very long time; so long, indeed, that some observers have been inclined to suspect actual solution, either of the metal or one of its oxides.

Reports have often been made from the amalgamation works of California and Nevada of water, apparently perfectly clear, taken from the flumes, or even from river-courses, at long distances below the mills, in which if pieces of sheet-copper, or the iron nails of wood-work, be allowed to lie for months or years, their surface becomes heavily amalgamated, the deposition of ounces and even pounds of mercury having been noticed.

It seemed possible that the effect of the long-continued grinding of mercury with the ores of silver and gold might be imitated in the laboratory by substituting for the metal in mass the "mercury with chalk" or "with magnesia" of the pharmacopœias, and that on treating this with water some evidence might be obtained of the taking up of quicksilver in a form which would not separate mechanically, at any rate for a long time. Senor Segura purified some clear commercial mercury by protracted warming and shaking with dilute nitric acid, washing, drying, and slowly distilling it in a glass retort. 10 grms. of mercury thus purified was thoroughly extinguished by trituration with 16 grms. of pure precipitated calcium carbonate. The resulting powder was twice boiled with 1 litre of pure water, and these portions of water rejected. It was then boiled with more distilled water in portions of 2 litres at a time in glass vessels, and allowed after each boiling to settle. The water decanted off was filtered through close French paper free from metallic oxides, allowed to stand for forty-eight hours, and the middle portion in the vesse (rejecting the upper and lower strata) carefully syphoned off. 10 litres of water, thus saturated with whatever mercury could be taken up and retained under the circumstances, was evaporated with exclusion of dust, adding at first a few drops of nitric acid, and toward the end a like quantity of hydrochloric acid, and finishing the evaporation to dryness on the water-bath. The almost invisible residue, treated with a few drops of water and a drop or two of solution of hydro-sulphuric acid, gave a slight brown precipitate, which seemed less in amount than that obtained from a solution of 1 milligrm. of mercury as mercuric chloride in the same bulk of water.

So that, as far as this one experiment goes, it appears to confirm the possibility of very minute traces of mercury being thus taken up by water, but to an extent, under the conditions named, of less than 1 part in 10,000,000.

(3.) *Analysis of a New Mineral containing Niobium, from Amhurst Co., Virginia.* By WM. G. BROWN, of Albemarle Co., Va.

A rare mineral, of which small pieces occur along with allanite, the latter quite abundant, in the county named, I have described in the *American Journal of Science* as a new species. Its chemical analysis was made by Mr. Brown, under my direction. It proved by no means an easy task, some of the separations having to be repeated several times before satisfactory results were obtained. The method adopted was as follows:—

The finely pulverised mineral was fused at a low red-heat in a platinum crucible with eight or ten times its weight of acid potassium sulphate until completely decomposed. The fused mass was left to soak in cold water,* strongly acidulated with hydrochloric acid, until it could be readily crushed with a stirring-rod. The watery solution was poured off, the insoluble metallic acids (niobic, tantalic, tungstic, and stannic) with a little iron washed several times by decantation with hot water, caught on a filter, and carefully washed. While still moist they were digested with yellow ammonium sulphide, which was filtered off, and the residue washed with dilute ammonium sulphide, then *separately* with dilute hydrochloric acid, and finally with water, dried, ignited, and weighed. The sulphides of tin and tungsten were precipitated from the ammonium sulphide solution by hydrochloric acid and weighed together, then fused with sodium carbonate, the mass treated with dilute hydrochloric acid, and the tin re-precipitated as sulphide, converted into oxide, and weighed. The tungsten was obtained by difference. In the insoluble metallic acids the presence of tantalum was ascertained, but it proved to exist in too small quantity (less than a twelfth of the niobium) to admit of accurate separation by Marignac's process, which was the one used, viz., by potassium acid fluoride in solution of proper strength of the mixed fluorides. To the filtered solution of the original fused mass was added the iron dissolved out from the metallic acids, nitric acid was added, and, after heating, ammonium hydrate. The precipitate obtained was filtered off and washed, redissolved in hydrochloric acid, again precipitated by ammonia and thoroughly washed, once more dissolved in a minimum of hydrochloric acid, and an excess of oxalic acid added. The precipitate produced was ignited, dissolved in hydrochloric acid, largely diluted with water, and boiled with sodium thio-sulphate to precipitate zirconium, this precipitate being then filtered off, ignited and weighed.† The filtrate therefrom was evaporated to a small bulk, and treated with an excess of boiling saturated solution of potassium sulphate and a few solid crystals of the same salt. After becoming quite cold the precipitate was filtered off, and washed with cold saturated solution of potassium sulphate, then dissolved in boiling water with a little hydrochloric acid, and the cerium metals thrown down

* Employed in order to admit of titanium being detected and determined in the solution. The absence of this metal, however, was proved.

† The metallic acids were also examined for zirconium; and thorium was carefully tested for, but was not detected.

as hydrates. The filtrate from the double sulphates was diluted, and yttrium and erbium also thrown down as hydrates. The lanthanum was separated from cerium and didymium by means of yellow mercuric oxide and potassium permanganate (Winkler's method), and didymium and cerium from one another by lead dioxide and nitric acid (Gibbs). A weighed portion of the yttrium and erbium oxides was treated with sulphuric acid, so as to produce the corresponding sulphates. The change of weight showed that erbium was almost exclusively present. The erbium absorption-spectrum was obtained with great distinctness with the solution. The filtrate from the oxalates thrown down in the early portion of the analysis was evaporated to dryness in a platinum dish, the residue ignited and treated with hydrochloric acid, which dissolved out iron and uranium with a little glucinum, leaving most of the last-named metal as difficultly soluble oxide. The solution was precipitated by ammonia, the precipitate ignited and weighed, treated with hydrochloric and nitric acids, leaving a little more glucina, and iron and uranium separated by ammonium carbonate. These metals were proved to exist as ferrous and uranous compounds in the mineral. The filtrate from the precipitation by ammonium hydrate was tested with ammonium sulphide, and lime and magnesia determined as usual. The alkalies were determined in a separate portion of the mineral, decomposed slowly but completely by heating with strong sulphuric acid. The water was expelled by heating over the flame of a Bunsen lamp, collected, and directly weighed. Considerable quantities of the mineral were brought into solution, and used in the determination of the minor constituents. The results were the following:—

Nb_2O_5 } Ta_2O_5 }	.. .. ..	48·66 { About 2 p.c. may be assumed to be Ta_2O_5.
WO_3 ..	.. .. ..	0·16
SnO_2 ..	.. .. ..	0·08
ZnO_2 ..	.. .. ..	2·09
Eb_2O_3 } Y_2O_3 }	.. .. ..	27·94 { About 1 p.c. may be assumed to be Y_2O_3.
*Ce_2O_3	.. .. ..	1·37
†La_2O_3	.. .. ..	3·92
‡Di_2O_3	.. .. ..	4·06
UO ..	.. .. ..	3·47
MnO ..	.. .. ..	trace
FeO ..	.. .. ..	2·04
BeO ..	.. .. ..	0·62
MgO ..	.. .. ..	0·05
CaO ..	.. .. ..	2·61
Li_2O ..	.. .. ..	trace
Na_2O ..	.. .. ..	0·16
K_2O ..	.. .. ..	0·06
F ..	.. .. ..	trace
H_2O ..	.. .. ..	3·19
		100·48

(To be continued.)

TRANSVERSE ABSORPTION OF LIGHT.

By W. ACKROYD.

IN a former paper (CHEMICAL NEWS, vol. xxxiv., pp. 75, 77) that change of selective absorption was dealt with which is seen upon heating certain coloured bodies. Elsewhere‖ I have shown that it is convenient to contradistinguish between this aspect of absorption and that where change of colour is observed without structural alterations, as, *e.g.*, where the strength of a coloured solution is increased, or a longer stratum of it looked through, for in both these latter instances a deepening of colour is observed. To these different manifestations of probably the same general phenomenon the names of *structural* and *transverse* absorption were applied, and it is with the latter that the present paper deals.

Some consideration of the subject will show that for its exhaustive study it seems necessary to ascertain the absorptive effects (1) of varying the stratum length of the coloured solution, whilst the strength is kept constant; and (2) of varying its strength whilst the stratum-length remains the same. By stratum-length I mean the thickness of solution traversed by a beam of light.

Two series of experiments were therefore commenced, but it was soon found that only one was necessary by my arriving at the following simple principle:—

§1. *A constant number of molecules of a substance, however variously aggregated, produce the same amount of transverse absorption.*—Thus if we take two solutions of permanganate of potash, one strong and the other weak, since we employ the same solvent in each case there is presumably no difference in the permanganate's state of aggregation in the weak and strong solutions. Now if one contains x grm. of salt per c.c. and the other say $\frac{x}{2}$ grm. per c.c., then a stratum-length of 3 centimetres of the former gives the same absorptive effect as 6 centimetres of the latter, for in each case a rectangular bundle of rays, 1 square centimetre in section, is acted upon by $3x$ grms. of the salt—

$$\left(3x = 6\frac{x}{2}\right).$$

This law is at the foundation of colorimetric methods of quantitative analysis; I believe, however, that it has not been applied hitherto to abstract science, and I shall refer to it as *the principle of constancy of absorption.*

§2. *Extension of the Principle of Constancy of Absorption.*—It appeared to me possible that a solution of a body might give the same amount of absorption as the solid itself of a thickness corresponding to its quantity in the menstruum, if in the latter its state of aggregation of the parts which affect light were unaltered or only slightly so. Plates of bichromate of potash were therefore made by rubbing down under a slow stream of water, and then washing with absolute alcohol. Parallelism of the surface having been ensured the thickness of the plate was ascertained by means of a micrometer screw reading to 0·005 m.m.

Now, given the thickness of the solid in millimetres the weight in grms. of a square centimetre of it is readily obtained, for it is the product of the thickness into 1·10th the sp. gr. number.* Again if in standardising our solutions we still keep to the metric system, the weight of this square centimetre of solid divided by the strength of the solution in grms. per c.c. will give the number of c.c. which contain an equal weight of the body in solution, o what is equivalent, the stratum-length in centimetres, which ought to give the same absorptive effect as the solid.

A couple of bichromate of potash plates gave the following figures, its sp. gr. being taken as 2·617:—

Plate.	Thickness in Millimetres.	Weight in Grms. o a Square Centimetre
1	1·51	0·3951
2	0·71	0·1858

No. 1 plate equalled in absorptive effect 16 centimetres of a solution containing 0·02458 grm. bichromate per c.c., since—

$$16x\ 0{\cdot}02458 = 0{\cdot}3932$$

No. 2 plate equally 6 centimetres of solution of strength 0·0309 grm. per c.c., since—

$$6x\ 0{\cdot}0309 = 0{\cdot}1854.$$

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* Cerous oxide, but with Cléve's formulæ and atomic weights for this and the corresponding lanthanum and didymium oxides.

† Containing a trace of Di_2O_3.

‡ Containing a trace of Ce_2O_3.

‖ *Philosophical Magazine* for December, 1876; and *Journal of the Physical Society*, vol. ii., pp. 110 to 118.

* Let the reader here bear in mind that the sp. gr. number is the weight in grms. of a c.c. of the substance.

Similar results were obtained in experiments comparing plates of cupric sulphate with solutions of that body.

§3. *New Method of Observation.*—From the foregoing results it is evident that only absorption experiments of the nature mentioned in §1 (1) need be performed, since data obtained in this manner will furnish one with any information required as to the effect when the strength is varied and the stratum-length kept constant. An accurate quantitative method was now required. A modification of Gladstone's prism-trough qualitative method seemed to me most desirable. For quantitative purposes, however, it was necessary to eliminate the dispersion introduced by a wedge-cell, and, moreover, to have some device whereby weak solutions of known strength could readily be used. These ends were attained by the method now to be described in detail.

FIG. 1.

Trough-cells of glass were made of various lengths and of about 1 square centimetre in cross section, or even less for the economy of the solutions studied. Their lengths in centimetres were as follows:—

20, 10, 10, 5, 2, 1, 1, 1.

Fig. 1 is a sketch of one of them. With such a series any stratum-length of solution could be interposed in the path of the beam up to 50 centimetres.

It was found necessary to have the ends at *a* and *b* fig. 1 of thin microscopic glass thereby reducing the absorption at the blue end of the spectrum to a minimum. It is likewise convenient to have two sets of such cells the one being cemented with marine glue for aqueous solutions, and the other with ordinary glue for certain solutions in which marine glue would be soluble. In working, the cells are placed in a train upon a small wooden platform, with the source of light at one end and the spectroscopic slit at the other. The spectroscope used was one of Browning's, with dense glass prism and movable telescope, to which is attached a vernier enabling one to read to 1 inch of arc. Where necessary the indications of the instrument have been reduced to wave-lengths by an interpolation curve constructed from data obtained by careful observation of the solar spectrum.

Now, in Gladstone's qualitative method,* where a wedge-cell containing vessel is employed and a prism to analyse the transmitted light, a rectangular spectrum is obtained with a wedge of absorption. In my quantitative method the representation of this rectangular spectrum with its wedge or curve of absorption is obtained by taking the cell-lengths as ordinates and the spectroscopic readings as abscissæ.

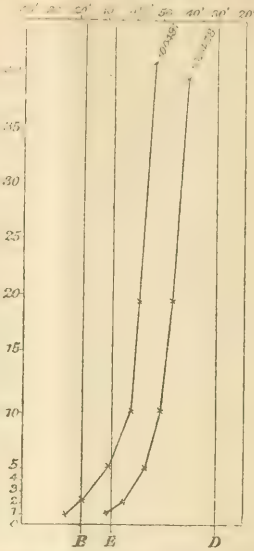
Fig. 2, which gives the results obtained with two strengths of bichromate of potash, will serve to illustrate the foregoing remarks. Each cross marks the termination of the absorption band extending from the ultra-violet. It will be observed (1) that by this method we eliminate dispersion, the light passing in the direction of the arrows in fig. 1, at right angles to the absorbing medium; and (2) that the results are quantitative.

§4. *Size of the Particles Producing Isolated Absorption Bands.*—In §2 we saw how to calculate the stratum-length of a solution of known strength equivalent to a certain thickness of solid. In the present paragraph we have to deal with the converse operation, *i.e.*, the calculation of thickness of solid equal to a certain stratum-length of a solution of known strength. In §2 we used the formula—

$$\frac{t\,m}{s} \quad . \quad . \quad . \quad . \quad . \quad (1.)$$

Where t = thickness of solid plate in m.m.; m = weight in grms. of 1 square centimetre of solid 1 m.m. in thickness; s = strength of solution in grms. per c.c.; and c = stratum-length of solution of known strength in centimetres.*

FIG. 2.



The figures at the end of the absorption curves give the strength per c.c. of the aqueous solution employed.

For our present object, therefore,—

$$\frac{c\,s}{m} = t \quad . \quad . \quad . \quad . \quad (2.)$$

We have it in our power now to approximately ascertain the size of the particles whose absorptive influence on light is first evident, for whatever may be the shape of such a molecular aggregate we cannot be far wrong for the present in assuming that its several dimensions are about equal. Hence if we calculate the thickness of solid plate required to give incipient absorption, we have at once the size of the particle which produces the same effect. Such numbers although only roughly approximate are of no small interest, and I therefore give those obtained for several bodies.

	Incipient Absorption.	Width of Molecular Aggregate in m.m.
Permanganate of potash	3 bands	80
Methylaniline violet ..	1 band	63
Magenta	1 „	47
Iodine green	1 „	480

For greater clearness we may take the observation for permanganate of potash in detail. The mean of two close determinations of its sp. gr. gave 2·349, hence m = 0·2349. The three principle absorption bands were just visible when 2 centimetres of solution, containing 0·0000095 grm. of the salt per c.c., were introduced between the light source and the spectroscope. Hence—

$$\frac{2 \;.\; 0{\cdot}0000095}{0{\cdot}2349} = 0{\cdot}0000808 \text{ m.m.},$$

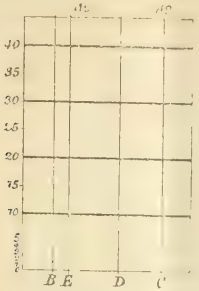
or 80 m.m.

* *Chem. Soc. Journ.*, x., 79

* c is really the number of c.c. of solution, but the light being transmitted through each in a straight line we may correctly call it the stratum-length in centimetres.

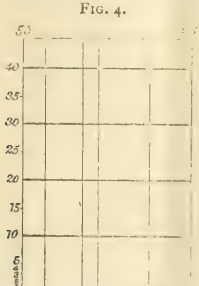
Figs. 3, 4, and 5 are the quantitative absorption spectra of methylaniline violet, $[C_{20}H_{16}N_3(CH_3)_3]$, iodine green, and magenta, $(C_{20}H_{19}N_3,HCl)$.

FIG. 3.



Aqueous solution of iodine green containing 0·0000147 grm. per c.c.

FIG. 4.



Aqueous solution of magenta, 0·000008 grm. per c.c.

§5. In comparative experiments on diathermancy, &c., physicists have employed plates of equal thickness. Similar comparisons for the absorption of light have not been hitherto tried, the difficulties in the way being apparently insuperable. It will be evident, however, that this may to some extent be effected by giving for the several bodies experimented with a common value to t in the formula §4 (1).

Fig. 6 presents such a comparison in which $t = 0{\cdot}00288$ m.m. apparently the most convenient thickness for the comparison. Now in §4 we have given the approximate widths of the molecular aggregate producing absorption, therefore if t (2880 m.m.) be divided by these figures, we obtain the number of particles in this particular thickness of plate employed; these are—

Iodine green	6
Permanganate of potash.. ..	36
Magenta	61

It is noteworthy that the greater the number of particles in the given thickness, or, in other words, *the smaller their size, and the more readily do short-wave radiations seem to be absorbed.*

In another paper I propose to apply the foregoing methods to the study of iodine solutions.

FIG. 5.

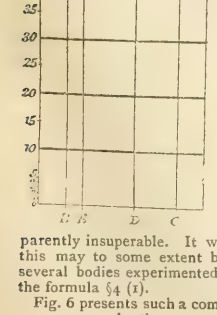


FIG.

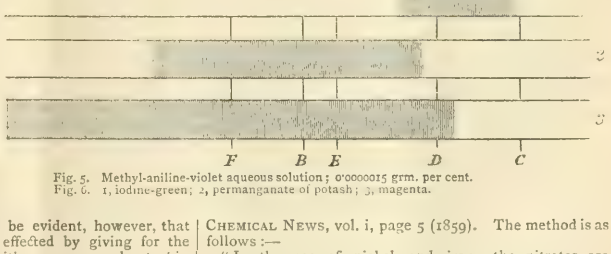


Fig. 5. Methyl-aniline-violet aqueous solution; 0·0000015 grm. per cent.
Fig. 6. 1, iodine-green; 2, permanganate of potash; 3, magenta.

A NEW AND READY METHOD FOR THE ESTIMATION OF NICKEL IN PYRRHOTITES AND MATTES.

By MARGARET S. CHENEY and ELLEN SWALLOW RICHARDS.

WE had occasion several months since, to make a number of determinations of nickel in mattes where, for commercial reasons, the element of time was of considerable importance. Our attention was thus called to the various processes which have been recommended for the separation of nickel from iron, and we have submitted these processes to comparative tests, but no one of them seemed perfectly satisfactory for our purpose.

The method most commonly used, perhaps, depends upon the separation of iron as a basic acetate. ("Fresenius," page 363.) This method requires considerable analytical skill and practice in its use. The large dilution and subsequent evaporation necessary render the operation a tedious one, even without the repeated re-precipitations which are indispensable to a complete separation.

The method based upon the behaviour of neutralised solutions at the boiling-point ("Fresenius," page 362), which we personally prefer to use, is open to the same objections. The process of separating the iron by ammonium hydrate, even with all the precautions recommended by various authors, has given very unsatisfactory results in our hands. By far the best success was obtained in the use of the method given by Frederick Field, in the CHEMICAL NEWS, vol. i, page 5 (1859). The method is as follows:—

"In the case of nickel and iron, the nitrates are evaporated nearly to dryness, and, after the addition of water, oxide of lead (litharge) is added, and the whole boiled for ten minute or a quarter of an hour. The iron

is entirely precipitated, the nitrates of nickel and lead remaining in solution. After filtration, which can be effected with great readiness, dilute sulphuric acid is added, and on standing for sixteen hours the sulphate of lead is filtered off, and the nickel precipitated and estimated in the usual manner."

This process uniformly gave good results as to the separation of iron and nickel, all the nickel being left in solution. The presence of lead in the solution was somewhat undesirable, the results being too high if the nickel was weighed as oxide, and much more caution was required in the battery precipitation. All these methods require two or three days, and the quantity of the ore or matte to be operated upon is limited, usually two to four grms.

Among the numerous tests made for a more ready way were those depending upon the solubility of the sulphates in alcohol and upon the behaviour of the oxalates, but no satisfactory results were reached. Finally a systematic series of tests was made with the phosphates, in the course of which it was found that phosphate of nickel is completely soluble, while phosphate of iron is almost insoluble in acetic acid, in the presence of an excess of phosphate of soda. Upon this fact, which we had not found mentioned in any work that we had consulted, we based the following process.

The ore or matte is dissolved in hydrochloric acid with the addition of a little nitric acid. All the metals of the arsenic and copper groups, if present, are separated by means of hydrogen sulphide with the usual precautions. The filtrate is boiled to drive off the excess of hydrogen sulphide, the iron is oxidised by nitric acid, and ammonium hydrate is added until a permanent precipitate begins to form, but not until complete precipitation is effected. Acetic acid is then added until the precipitated ferric hydrate is re-dissolved and the liquid is of a deep red colour, though not transparent. To this boiling hot solution ordinary phosphate of soda is added in excess, and the nearly white precipitate is filtered and washed with hot water containing acetic acid. The filtrate is heated nearly to boiling, and caustic potash added until the odour of ammonia is distinctly perceptible. The apple-green precipitate of phosphate of nickel is partially washed, dissolved in a little *dilute* sulphuric acid, the solution rendered strongly alkaline by ammonium hydrate and the nickel precipitated by the battery.

If the ore contains more than 3 per cent of nickel, it is necessary to dissolve the precipitate of phosphate of iron in hydrochloric acid, dilute this solution somewhat, render it nearly neutral by ammonium hydrate, add 25 or 30 cubic centimetres of acetic acid, and re-precipitate by phosphate of soda. The filtrate is added to the first filtrate. If the solution has been rendered alkaline before the addition of acetic acid, or if an insufficient quantity of phosphate of soda has been used, a small amount of iron will remain in the solution, not enough, however, to interfere with the battery precipitation of the nickel. The solution of phosphate of soda should be a saturated one, and, if it is heated separately, the troublesome boiling of the bulky precipitate is avoided. By the aid of the filter pump this precipitate is readily filtered, in spite of its unpromising appearance.

The advantages of this method are: 1st, the concentration of the solution. It may contain 10 to 15 grms. of ferric oxide in a half litre, instead of 1 grm., as in the basic acetate method, and thus larger quantities of a poor ore may be operated on. 2nd. A great saving of time. The nickel may be weighed in eight or ten hours from the time the ore is pulverised and ready for solution. This saving of time is mainly due to two causes. First, less care is required in case of precipitating as phosphate than as basic acetate. Second, in precipitating phosphate of nickel by caustic potash it is not necessary to concentrate the solution nor to expel all the ammonia as is the case in precipitating as hydrated oxide. An unexpected advantage is the more ready battery precipitation of the nickel from the solution of the phosphate.

Two of the so-called quart carbon cells, each half-filled with the solutions (bichromate of potassium and sulphuric acid) were found quite sufficient to precipitate the nickel completely in two hours. If a strong current was used, the nickel was precipitated in a black, spongy form.

A solution containing 0·375 grm. Ni as chloride, and 1·183 grms. Fe as chloride was made up to 250 c.c.

	Used.	Found.	Per cent.
100 c.c.	0·1487	0·150	99·06
100 c.c.	0·1487	0·150	99·33
50 c.c.	0·0748	0·075	99·73

To the first portion the phosphate of soda was added first, and the acetic acid afterward.

		Per cent.	
Matte No. 1 gave	(phosphate method)	6·77	Cheney.
	" "	6·861	Richards.
	" "	6·48	
Matte No. 2	" (neutralised solution)	2·081	Richards.
	" "	2·37	
	" (phosphate method)	2·15	Cheney.
Matte No. 3	" (phosphate method)	7·22*	Richards.
	" "	7·41†	Hardman.
	" (basic acetate)	7·79	Hardman.
Pyrrhotite No. 1	(basic acetate)	0·32‡	Hardman.
	" "	0·29	
" "	(phosphate method)	0·33‖	Cheney.
	" "	0·25	
Pyrrhotite No. 2	(phosphate method)	0·725	Richards
	" "	0·686	

—*American Journal of Science and Arts.*

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.§

By Dr. A. W. HOFMANN.

(Continued from p. 150.)

Ammonia and Ammoniacal Salts. By M. SEIDEL, Director of a Manufactory in Amsterdam.

Applications of Ammonia.—As already mentioned the consumption of sulphate of ammonia in agriculture has become more and more established. In comparison with guano and with all putrescent manurial matters this salt has the great advantage that all its ammonia is combined, and, although in consequence of this fact the effect is less rapid than that of guano, it is decidedly more permanent.‖

The production of caustic ammonia likewise has manifestly increased. Large quantities are required by Carré's ice-machine, which, although still encumbered with a variety of defects is daily finding a more extended application.¶

Caustic ammonia is also more and more required in the tinctorial arts, and very recently it has unexpectedly come into use in the preparation of indigo in Java.

* Mrs. Richards lost a portion of the washings by the breaking of a beaker.

† This was Mr. Hardman's first trial of the phosphate method, and not enough phosphate of soda was added to produce a *white* precipitate.

‡ "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

§ Recently repeated attempts have been made to extract by direct lixiviation the ammonia which accumulates in the composition employed in gas-works for purifying purposes (bog-iron ore and sawdust) and to utilise it as manure. In consequence, however, of the abundant presence of sulphocyanide in the sulphate, and of its pernicious action upon vegetation, these experiments have led to no favourable result. —(Private communication of Dr. L. Darmstädter to the Editor).

‖ Compare the paper by Dr. Meidinger in an earlier portion of this Report.

According to the old process for the preparation of the colour from various species of *Indigofera*, lime was added to the fermenting mass. A Belgian chemist, J. Sayers, of Djocjocarta, in Java, has introduced there a new process. Instead of lime he adds ammonia during the fermentation, and is said in this manner to obtain a purer colour.

The successful resumption of the method tried more than thirty years ago to produce soda by treating chloride of sodium with carbonate of ammonia, has also lately given a considerable impulse to the manufacture of ammonia. Should, as it almost appears, the ammonia-soda process come into use on a larger scale this circumstance would very essentially contribute to a further development of ammonia manufacture.*

The condensibility of ammonia and its great solubility in water have inspired the idea of using it as a motive power for machinery.

The earliest experiments in this direction are due to Tellier and Flandrin.† In connection with these attempts Tellier has subsequently sought to make ammonia useful in a variety of technological applications, but without arriving at any decided success, which may be partially due to the circumstance that the commercial value of ammonia has so greatly increased of late years. Tellier has collected his suggestions and published them in a separate work—"L'Ammoniaque dans l'Industrie." Paris: J. Rothschild, 1867. Delaporte‡ also has patented an ammonia machine in France.§

We may in conclusion briefly mention a few proposals respecting the preparation of various ammoniacal compounds.

As is well known ammonia is fixed not only by acids but by many salts, which in this case play the part of an acid. These compounds, which have been experimentally examined by H. Rose, Persoz, and Rammelsberg, give off the ammonia when heated, a property which is often used in the laboratory for the preparation of liquefied ammonia. Latterly Knab‖ has proposed to obtain such saline compounds of ammonia industrially, and to store up the gas in this form. Such compounds would then only require a gentle heat in order to evolve a current of dry ammoniacal gas. Chloride of calcium can in this manner take up 50 per cent of its weight of ammonia, whilst strong liquid ammonia contains only 20 per cent of dry ammonia. This latter assertion is an error, since water, even at 15°, is capable of taking up more than 30 per cent of its weight of ammoniacal gas.

Ammonium sulphide, so frequently employed for analytical purposes, has been hitherto almost exclusively prepared by passing sulphuretted hydrogen into caustic ammonia. It is now obtained by Spence§ industrially by mixing ammonium sulphate or chloride with twice its weight of alkali-waste or gas-lime, exposing the mixture to the action of steam, and condensing the products of distillation in suitable apparatus.

Kunheim¶ has introduced a simple, but under certain circumstances very advantageous, improvement in the manufacture of ammonium carbonate. Previously this salt had been almost exclusively prepared by the double decomposition of sal-ammoniac and carbonate of lime, the chloride of calcium, relatively worthless, being obtained as by-product. Kunheim employs instead of carbonate of lime the carbonate of baryta, and obtains a solution of baric chloride, which may be advantageously used in the preparation of permanent white.

Nitric Acid and its Salts. By Dr. Adolph Geyger, of Berlin.

Even at the commencement of the present century a part of the saltpetre consumed in the various countries of Europe came from India as so-called exotic saltpetre,* and the rest of the supply was obtained as native saltpetre by the lixiviation of natural or artificial nitre beds.

The consumption of nitrates in the chemical arts and in the manufacture of gunpowder and of other blasting materials has increased to such an extent that the earlier sources became utterly insufficient. A new supply was laid open in the vast deposit of a mineral very rich in nitrate of soda, discovered more than fifty years ago in the district of Tampa, on the border between Chili and Peru.† The extraction of this deposit is still on the increase and furnishes by far the largest part of the raw material for the nitrates now used in the arts.

According to the statements of Dr. G. Langbein‡ there were in the year 1871 in the Peruvian nitre districts eleven large refineries with a daily production of about 6000 cwts. purified nitrate of soda. The nitriferous mineral, called *caliche*, is found in beds from 0·25 to 1·5 metre in thickness, which, however, rarely rise to the surface. The superincumbent rock, *costra*, is from ¼ to 2 metres in thickness, and consists principally of a hard conglomerate of sand, felspar, phosphates, and other minerals. The composition of the caliche fluctuates; it contains 48 to 75 per cent nitrate of soda, 20 to 40 chloride of sodium, and varying quantities of sulphates of soda and lime, nitrate and iodate of potassa, chloride of magnesium, &c., as also insoluble earthy matters and organic substances (guano). It is first broken up in a disintegrator and placed in the dissolving pans. Some of the establishments use long four-sided cisterns, but the better arranged works use closed egg-shaped boilers provided with two movable covers, of which the upper serves for the introduction of the caliche, and the lower for the removal of the exhausted material. The mass rests upon a perforated false floor fixed at about one-fourth the height of the boiler, and consisting of four pieces movable on hinges. The boilers are filled up to the top with the broken raw material, and up to half height with mother-liquor, and are heated by the direct action of steam, which is admitted by four pipes reaching below the false bottom. In from one and a quarter to two and a half hours the liquid is sufficiently saturated with nitre and is let off into settling tanks; after some hours' rest the clear liquid flows into flat crystallisers fixed in an open place and exposed to the wind. Latterly a second settling-tank has been interpolated, in which the liquid is allowed to remain for about half an hour, in order to deposit the common salt which is held in mechanical suspension beforebeing run into the crystallisers.

The residue left in the boilers, which still contains from 15 to 35 per cent soda saltpetre, is either cleared out at once or extracted once more with spring water. The closed boilers are simply emptied by letting down the lower or true bottom, when the residue falls into waggons run in beneath, and is drawn away from the works. The crystals of nitre which form in the crystallising pans after the mother-liquor is drained away are spread upon a large surface exposed to the wind, and called *cencha*, in layers of from 30 to 50 centimetres in thickness, and dried by being frequently turned over. The total cost of 1 cwt. of Chilian saltpetre up to its conveyance to Europe was calculated in the year 1871 by Langbein, as follows:—

* According to private communications which the Editor has received from German manufacturers an increase of the demand for carbonate of ammonia, in consequence of its application to the ammonia-soda process, is as yet scarcely perceptible.—(A. W. H.)

† Tellier and Flandrin, *Comptes rendus*, lx. 593; *Mount. Scientifique*, 1865, 134; *Dingl. Pol. Journ.*, clxxvi., 163; *Deutsch. Industrie Zeitung*, 1865, 120; *Wagner Jahresber.*, 1865, 279.

‡ Delaporte, *Cosmos Industr.*, August, 1865, 63.

Lamm, of New Orleans, is said (*Engineer*, Jan., 1875) to have constructed an ammonia-machine, which has been successfully tried for street-tramways, the chief difficulty, the loss of ammonia, is almost overcome by the use of an oil joint in the stuffing boxes.

§ Knab, Chem News, 1866, xiii., 102; *Deutsche Industrie Zeitung*, 1866, 178; *Wagner Jahresber.*, 1866, 295.

‖ Spence, *Mech. Mag.*, Nov., 1866, 397; *Dingl. Pol. Journ.*, clxxxiii., 397; *Polyt. Centralb.*, 1867, 461.

¶ Kunheim, *Deutsche Industr. Zeit.*, 1866, 178; Chem. News, 1866 xiii., 192; *Wagner Jahresbr.*, 1866, 202.

* The terms exotic and native saltpetre are not known in the English trade.—*Ed.* C.N.

† Rivero, *Schweigger's Journ.*, xxxiv., 450

Langbein, *Wagner's Jahresber.*, 1871, 300, and 1872, 290.

Cost of production	3·25	marks
Conveyance to the coast	2·40	,,
Cost of shipping	0·25	,,
Freight to Europe	2·75	,,
Charges on arrival	0·25	,,
	8·90	,,

or about 8s. 8d.

W. Lloyd,* in 1868, calculated the cost of production at 8·40 marks per cwt. The rise of price in spite of the improvements in the process of purification, is due to the enormous increase in the cost of labour and in the freight to the Port Iquique. Although the saltpetre districts have been now for some years connected with the port by a railway, the greatest part of the produce is still conveyed upon mules.

The exportation of nitre is still constantly on the increase, as the following figures prove:—

1830	18,700 cwts.
1835	140,399 ,,
1840	227,362 ,,
1850	511,845 ,,
1860	1,370,248 ,,
1870	2,943,413 ,,
1871	3,605,906 ,,
1872 .. .. Upwards of 4 million cwts.	

By the decree of July 12th, 1873, the Peruvian Government has taken the saltpetre trade into its own hands, and has fixed the quantity that may be yearly exported at 4½ million cwts. As to the effect of this monopoly upon the saltpetre trade, no decision can as yet be formed.

As a specimen of the composition of the purified soda saltpetre, as imported into Europe, the following very complete analysis, published by Wagner,† may be cited:—

Sodium nitrate	94·03
,, nitrite	0·31
,, chloride	1·52
,, sulphate	0·92
,, iodate	0·29
Potassium chloride	0·64
Magnesium chloride	0·93
Boracic acid	trace
Moisture	1·36
	100·00

The mother-liquor of the refineries contains from 2½ to 5 grms. iodine per litre, and is used in some Peruvian establishments as a source of that body. (Compare chapter on Chlorine, Bromine, and Iodine.)

As to the origin of these saltpetre beds in Peru various explorers have published their opinions, but without giving a fully satisfactory explanation. Indeed it would almost seem as if the formation had taken place under circumstances which have remained hitherto unknown. According to H. Reck‡ Chili saltpetre is the oxidation product of large guano beds, whereby, however, as Nöllner very justly remarks, it remains unexplained what can have come of the great mass of sparingly soluble phosphate of lime, whilst the readily soluble nitrate of soda remains behind.‖

(To be continued.)

The Commission of the Academy of Sciences and the Experiments of MM. Pasteur and Bastian.—This commission has proved a failure, and has never even witnessed the experiments of Dr. Bastian. With whom the blame must rest it would be premature to decide.—*Moniteur Scientifique.*

* Lloyd, *Wagner's Jahresber.*, 1869, 247.

† R. Wagner, *Wagner's Jahresber.*, 1869, 248.

‡ H. Reck, *Berg.u. Hüttan. Zeit.*, 1869, 188, 207, 225, 229; Wagner, *Wagner's Jahresber.*, 1869, 323.

‖ Without wishing to advocate the guano theory, we may point out that the *costra*, or superincumbent rock, has just been described as consisting in part of phosphates.—ED. CHEM. NEWS.

NOTICES OF BOOKS.

Report on Public Health. By CHARLES A. CAMERON, M.D. Dublin: Printed for the Author.

THIS pamphlet comprises a number of distinct essays on subjects connected with public health. The first of these essays is devoted to the consideration of the use of stimulants in public institutions, the latter term being here used to signify workhouse-hospitals. Several interesting cases of the adulteration of alcoholic beverages are given. Thus, a sample of port examined by the author, for the Guardians of Kilrush Union, contained, per pint, 886·8 grains of sugar, chiefly cane. The so-called Hambro' sherry, largely used in Ireland, and still more in England and Scotland, is made up of "silent spirit," sugar, and a small proportion of genuine wine. He recommends, instead of sherry, marsala; and instead o port, Carlowitz, as being more easily obtained in a state of purity.

A Plan for rendering Salted Meat more Nutritious, thereby preventing Scurvy. By R. GALLOWAY, F.C.S. Dublin: Hodges, Foster, and Co. London: Simpkin and Marshall.

THE author recommends that phosphate of potash should be added to salt meat, with a view of supplying principles in which it is deficient, as the proportion naturally present is almost entirely eliminated in the process of salting. Strangely enough, this very simple, and by no means disagreeable, prophylactic cannot secure a trial either in the Royal Navy or in merchant ships, though medical men admit that it could not prove injurious in any case, even should it prove ineffectual. We meet with the curious and novel piece of information that lime-juice, the favourite safeguard against scurvy, acts in many cases as an anaphrodisiac, and that its use is avoided by sailors and others on that account whenever possible. Is this property common to all the vegetable acids?

CORRESPONDENCE.

DAVYUM.

To the Editor of the Chemical News.

SIR,—I beg to correct the table of the solubility of the sodium-davyum chloride compound mentioned in my second communication on the metal davyum (CHEMICAL NEWS, vol. xxxvi., p. 114), as follows:—

Temperature. C.	In 100 parts of— Alcohol.	Water.
0·0	0·05	0·09
20·0	0·08	0·11
40·0	0·10	0·14
70·0	0·07	0·10
78·3	0·06	—
100·0	—	0·08

—I am, &c.,

SERGIUS KERN, M.E.

REVERSAL OF THE SODIUM LINES.

To the Editor of the Chemical News.

SIR.—Lately my attention has been called to this phenomenon as occurring in a manufacturing operation, by my friend Mr. T. E. Hoyle, of Blackley. In the making of nitrite of soda, as your readers are aware, small coal and carbon are thrown on to the fused nitrate of soda, and instantly there is a blaze up from the combustion of these materials. Now, if the spectroscope be directed to this

source of light for the few moments it lasts, the D lines are observed to be beautifully reversed, and I do not remember to have seen the phenomena so well produced before.

The various conditions under which *reversion* may be produced cannot fail to interest chemists as well as physicists; and the former who have facilities for observations of this kind, in the manufacture of salts of the alkaline earths, especially nitrites under the conditions stated above, would add to our limited stock of knowledge by reporting the facts they learn.—I am, &c.,

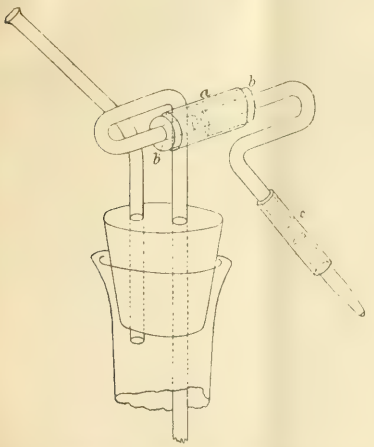
Wm. Ackroyd.

Science Schools, South Kensington,
October 1, 1877.

USEFUL JET FOR A WASH-BOTTLE.

To the Editor of the Chemical News.

Sir,—A more universally useful jet for a wash-bottle than the one figured in the Chemical News (vol. xxxvi., p. 119) is in general use in Prof. Bunsen's laboratory at Heidelberg (also figured in Prof. Thorpe's "Quantitative Analysis"). *a* represents a piece of stout glass tube; *b b* are two corks; and *c* a piece of india-rubber tube, and one finger suffices to guide the jet in all directions. The arrangement does not get out of order.—I am, &c.,



Chas. O. Trechmann, Ph.D.

Hartlepool, September 15, 1877.

JOURNAL OF THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—On page 373 of the newly-issued number of the *Journal of the Chemical Society* I notice an abstract of a foreign paper on "Differences observed in Unadulterated Milk." The author (E. Reichardt) observes that "the specific gravity of cow's milk varies from 1·018 to 1·045, but is generally 1·040." Some important analyses follow, in which no mention is made of the existence of "ash," though the results "add up" to 100.

At a recent meeting of the Chemical Society, at which the subject of the *Journal* and its contents was pretty freely discussed, attention was drawn to the utterly useless and scientifically worthless paragraphs which are occasionally allowed to figure in a permanent place of honour in its pages, notwithstanding the pressure of valuable "over matter" remaining on the printer's table month after month. The above is a forcible case in point. What is the use of retailing to the readers of the *Journal of the Chemical Society* such utter nonsense as that enunciated in the first sentence of the paragraph from which I have quoted? It appears to me that from the publication of such abstracts three consequences follow:—First of all, there is a decided waste of space—in this case about half a column; secondly, there is the possibility of dangerously misleading a tyro, who might, not unnaturally, be inclined to attach weight to statements of such a nature, abstracted without comment in a publication of such high authority; thirdly, there is the effect of bringing down some well-merited ridicule upon the original author of the paper. If these consequences justify the appearance of such an abstract, by all means let it appear; but the propagation of notoriously erroneous facts by such a medium as a standing English record of chemical science seems to me, for many reasons, most undesirable.—I am, &c.,

Analyst.

London, October 1, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 12, Sept. 17, 1877.

New Researches on the Ammoniacal Fermentation of Urine, and on Spontaneous Generation.—P. Cazeneuve and C. Livon.—The experiments of the authors confirm the views of M. Pasteur, and lend no countenance to the hypothesis of generation not due to pre-existing germs.

Moniteur Scientifique Quesneville. September, 1877.

Constitution of Ultramarine.—J. Philipp.—Taken from Liebig's *Annalen*, clxxxiv., p. 132.

Chemical Equivalents and Atomic Weights as Bases of a System of Notation.—M. C. Marignac.

Observations on Chemical Equivalents as Compared with Corpuscular Elements.—A. Baudrimont.—These two papers are contributions to the recent controversy between M. Berthelot and M. Würtz.

Reports of Foreign Researches.—M. F. Reverdin.—These consist exclusively of papers extracted from the *Berichte der Deutschen Chemischen Gesellschaft* and noticed elsewhere.

Analysis of Butter as regards the Detection of Foreign Fats.—M. Otto Hehner.—The contents of this paper may be found on reference to the author's English work on the same subject.

On Carbuncle and Septicæmia.—MM. Pasteur and Jourbert.—Taken from the *Comptes Rendus*.

Etiology of Carbuncular Disease.—M. Colin.—A pathological paper.

Note on Dr. Bastian's Experiments on Urine Neutralised with Potassa.—M. Pasteur.—Taken from the *Comptes Rendus*.

Sources of Carbonic Oxide.—M. Lorin.—Unsuitable for abstraction.

Magnetism of Nickel and Cobalt.—M. Hankel.—With feeble currents the magnetic power of nickel is equal to that of soft iron, but with stronger currents it is comparatively feeble. The magnetic power of cobalt under any circumstances is much lower than that of the two other metals.

Novel Colouring Matters.—MM. E. Willm, G. Bouchardat, and Ch. Girard.—This paper will be inserted in full.

French Association for the Advancement of Science.—An announcement of the proceedings of the Association.

The Iodide of Starch: The Theory of its Decolouration by Heat and of its Recolouration on Cooling.—M. H. Pellet.—Reserved for insertion in full.

Plastered Wines.—M. Marty.—In a ministerial circular it is decreed that no wine shall be received in the military hospitals if it contains more than 2 grms. sulphate of potassa per litre. The author accordingly gives a process for determining if this limit is exceeded. (Why "plastering" should be tolerated at all might prove a very difficult question to answer.)

Detection of Resin in Soaps.—M. C. Barfoed.—The author decomposed the soap with hydrochloric acid and washes the mass thus obtained with water. He then treats it with a lye of caustic soda of sp. gr. 1·1°, diluted with six volumes of water, avoiding excess. He then evaporates to dryness in the water-bath, grinds up the residue, and dries in the stove at 100°. One portion of this powder is utilised for the determination of the fatty acids. Another portion is put in a very dry bottle, and 5 to 10 c.c. of absolute alcohol are added for every grm. of soap. It is heated to 80° to dissolve the soaps of the fatty acids and of resin, and allowed to cool again, well stoppered. The alcoholic liquid when cold is mixed with five times its volume of ether, the whole is well shaken up and left to settle. The resin soap is entirely dissolved, whilst the soap of the fatty acids is deposited almost entirely. After standing for 24 or 48 hours the ethereal liquid is decanted, evaporated, and the residue is treated with hydrochloric acid. This method is based upon the slight solubility of a soda-soap of the fatty acids in the above-mentioned mixture of alcohol and ether.—*Zeitschrift f. Analyt. Chemie*, xiv., 20.

Detection of Free Hydrochloric Acid in Admixture with Chlorides.—M. Loewenthal.—If red lead is added to the solution of a chloride containing free hydrochloric acid, this oxide is decolourised and chlorine is given off. The reaction does not succeed in presence of ferric and stannic chlorides, but it gives a good result along with the chloride of aluminium.—*Zeitschrift f. Analyt. Chemie.*

Detection of Traces of Iron in Salts of Nickel.—M. Bœttger.—A solution of nickel is poured into a test-tube, acidulated slightly, and a few drops of sulphocyanide of potassium are added. On agitating the mixture with a few c.c. of ether, we obtain a rose-coloured ethereal stratum if the smallest quantity of iron is present. To remove all iron, the aqueous solution of the nickel salt is boiled for ten minutes with protocarbonate of nickel, or, in default of this salt, a few drops of carbonate of soda are added. Finally the whole is filtered, when the iron remains upon the filter with the excess of nickel carbonate.—*Neues Repert. f. Pharmacie*, 1875, p. 621.

Preparation of Thallium.—M. J. Krause.—Three casks are set one above the other, so that the contents may be drawn from one to another by means of a syphon. In the upper cask the flue-dust is exhausted with water heated by a jet of steam. The clear concentrated liquid is run into the second cask, where the thallium is precipitated by hydrochloric acid. The washing liquors are reserved for a new operation. The precipitation of the chloride of thallium is rendered more complete by briskly agitating the solution. When the liquid is drawn off, the second cask is filled with pure water mixed with a sufficient quantity of sulphate of soda to give it the same degree of concentration as before. The agitation of the mixture determines a slow decomposition, and the liquid flows off into the lower cask, where it is acidulated with sulphurric acid, and the thallium is precipitated with plates of zinc. The spongy thallium is well washed, strongly compressed, and melted in a crucible. The author has obtained 10½ kilos by this method.—*Dingler's Polytech. Journal*, ccxvii.

Les Mondes, Revue Hebdomadaire des Sciences,
Sept. 13, 1877.

At the forthcoming Paris Exhibition there will be distributed 1000 gold medals, 4000 medals of silver, 8000 of bronze, and 8000 honourable mentions, besides 100 grand prizes and exceptional rewards in silver.

Zinc powder, which is now an article of commerce, and is used in the tinctorial arts and in certain chemical manufactures, is composed as follows:—Zinc, 40; lead 2·5; cadmium, 4; zinc oxide, 50; zinc carbonate, 3·5; total, 100·0; non-metallic dust, traces. If moistened it becomes spontaneously inflammable, and according to *Dingler's Journal* has occasioned conflagrations on board ship.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 45, September, 1877.

Report by M. S. Cloëz, on behalf of the Committee of the Chemical Arts on M. Sourdat's "Draining Turbine" for Laboratory Use.—The apparatus in question is a kind of hydro-extractor, the precise arrangement of which is scarcely intelligible without the aid of illustrations.

Studies on Nitro-glycerin and Dynamite.—A. Brull.—These compounds are here considered from the point of view not of the chemist, but of the engineer.

TO CORRESPONDENTS.

James Muir.—The salt used by calico-dyers is not the hyposulphite but the hydrosulphite of soda. Hyposulphite is, however, used to some extent as a mordant in dyeing, and as an "antichlore" in bleaching.

G. Lamy.—We know of no special work on the subject.

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THE CHEMICAL NEWS.

VOL. XXXVI. No. 933.

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

No. VI.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(Concluded from p 158.)

(4.) *Analysis of Native Antimony Ochre from Sevier Co., Arkansas.* By J. R. SANTOS, of Guayaquil, Ecuador.

This mineral accompanies stibnite in a vein of the latter of workable dimensions. Specimens of it were sent me by a former student, Mr. C. E. Wait. The ochre occurs in pieces of considerable size, sometimes several pounds in weight, of coarsely fibrous or bladed structure, like that of the sulphide from whose alteration it has doubtless been produced, of straw-yellow colour, in parts tinted brown by iron. The hardness is a little over 4. The sp. gr. = 5·58. After drying the mineral at 100° C., water was driven off by heating in a stream of carbon dioxide, and collected in a chloride of calcium tube. The remaining oxide was very gently heated, and hydrogen passed over it, the water formed being collected as before. The residue in the tube was pure metallic antimony, with the exception of a little siliceous residue left on solution in acid. The analysis gave—

Sb (by difference)	76·15
O	19·85
H_2O	3·08
Insoluble siliceous matter	0·92
	100·00

These numbers represent pretty nearly the ratio—

$$Sb : O : H_2O = 4 : 8 : 1,$$

giving the formula $2Sb_2O_4.H_2O$; or if the true hydrate, as artificially produced, be $Sb_2O_4.H_2O$, this ochre may very possibly be a mixture of Cervantite (anhydrous Sb_2O_4) and stibiconite ($Sb_2O_4.H_2O$).

(5.) *Examination of an Unusual Form of Stibnite from Oregon.* By J. R. SANTOS.

Amongst some minerals from the Cabell Mine, in Elk Creek district, Grant Co., Oregon, was a specimen labelled "Jamesonite, with pyrargyrite." The red silver ore was in small quantity, but easily identified; the chief portion of the mass, beside a quartz gangue, consisted of little globular masses, from a quarter to half an inch in diameter, more or less compacted together, and often presenting a thin shell of quartz on the exterior, with crystalline outside surface. The nodules on being broken across showed a fine fibrous structure, the fibres radiating on all sides from the centre: the colour was dark bluish grey, with metallic lustre; the general appearance much like that of some specimens of Jamesonite and Zinkenite. It was supposed to be one of these species, or possibly new, and was handed over to Mr. Santos for analysis, but on examination it proved to be simply stibnite—the ordinary sulphide of antimony. The specific gravity, too, was found to be that of the common mineral.

(6.) *Analysis of Auriferous Cobalt Ore from Grant Co., Oregon.* By ST. GEORGE T. BRYAN, of Fluvanna Co., Virginia.

In the same lot of Oregon minerals (for which I was indebted to Mr. F. E. Cabell of that State) in which the above stibnite was found there were some specimens illustrating an uncommon association of gold, namely, an auriferous ore of cobalt from Dixie Creek, Grant Co. Through a quartose gangue the ore was distributed in little strings and grains of greyish white colour and metallic lustre. H = 5; sp. gr. 5·36. It was associated with some little visible particles of copper pyrites, and more or less crusted over with an earthy product of oxidation, partly white, in parts coloured pink by cobalt. Breaking up several of the larger pieces, the purest grains of the ore which could be seen were picked out for analysis, but, as the results show, the separation was by no means complete. Mr. Bryan's analysis yielded—

S	3·23
As	49·19
Bi	1·31
Co	11·19
Ni	3·79
Fe	12·82
Cu	2·44
Au	trace
As_2O_5	2·30
Cl	trace
CoO	trace
MgO	0·94
Na_2O	0·30
K_2O	0·40
SiO_2	9·71
H_2O	1·52
	99·14

These numbers agree well with the proximate composition—

Smaltite (ferriferous)	76·88
Chalcopyrite	7·09
Arseniates (Hörnesite, erythrite, &c.)	5·46
Quartz	9·71
Gold	trace
	99·14

In the smaltite the atomic ratio—

$$\left\{\begin{matrix}Co\\Ni\\Fe\end{matrix}\right\} : \left\{\begin{matrix}As\\Bi\\S\end{matrix}\right\} = 4450 : 6856,$$

or nearly $R_2''As_3$. The occurrence of alkaline arseniates, even though in very small quantity, along with the corresponding salts of magnesium and cobalt, is interesting; the former were in part dissolved out by water, and separately identified. Assay upon the large scale had shown that the gold was present to the extent of about 6 ounces per ton of ore.

(7.) *Analysis of Aluminous Chrysocolla from Utah.* By J. R. SANTOS.

Amongst some copper ores obtained from the Baltimore Copper-smelting Works there were several specimens of chrysocolla from Utah, partly earthy and partly vitreous in appearance. Some fragments of the latter variety, apparently very uniform and free from any admixture, were selected for analysis. The mineral was light greenish blue in colour, with a pale blue streak, sub-translucent. H = not much over 2. An attempt of Mr. Santos to take the specific gravity was foiled by the large absorption of liquid by the mineral, of which no pure fragment could be found large enough to be readily protected by varnish. On analysis the following results were obtained:—

SiO_2	37·19
Al_2O_3	10·78
CuO	26·03
H_2O	25·76
	99·76

The oxygen ratio—

$$SiO_2 : Al_2O_3 : CuO : H_2O = 1240 : 315 : 329 : 1431,$$

Hence we have the normal meta-silicate formula for chrysocolla, $CuSiO_3.2H_2O$, with some water in excess, and with *one-half the copper replaced by an equivalent amount of aluminum.* Although several analyses on record include aluminum as a constituent, I know of none containing half as much as appears in this case; the next largest proportion which I find being 4·97 per cent in a specimen from Coquimbo in Chili, analysed by Field (*Phil. Mag.*, [iv.], xxii., 361).

University of Virginia,
August 31, 1877.

NOTE ON THE ACTION OF SILVERED ZINC FOIL ON AMMONIUM FORMATE, &c.

AMMONIUM formate ($HCOONH_4$) solution is decomposed by zinc, especially in presence of copper or silver. With silvered zinc the action begins and continues at the ordinary temperature; on warming, the evolution of gas (hydrogen and ammonia) is very strong. The formic molecule is not affected, the action being a simple replacement of $2NH_3$ by Zn.

$$2HCOONH_4 + Zn = \left\{\begin{matrix} HCOO \\ HCOO \end{matrix}\right\} Zn + 2NH_3 + H_2.$$

Experiment.—An excess of silvered zinc-foil was permitted to work exhaustively on strong ammonium acetate solution. Some of the clear solution being evaporated (spontaneously), yielded brilliant, transparent, cubical crystals, not deliquescent in the air, and insoluble in alcohol, and yielding ZnO on ignition. CH_3COONH_4 is decomposed in an analogous manner by silvered zinc, ammonia, hydrogen, and zinc acetate being formed. The action is not so energetic as with the formate.

W. R. H.

Würzburg.

AN ANCIENT SPECIMEN OF TIN.

By Prof. A. H. CHURCH.

TOWARDS the close of the year 1875 a mummy, which had been recently brought from Egypt by Lord Eustace Cecil, was unrolled under the superintendence of Mr. R. H. Soden-Smith, of the South Kensington Museum. Beyond a strip of white metal nothing was found within the cloths of the embalmed body. This strip of metal was embedded in pitch resting on the breast in contact with the flesh—the usual position of the Scarabæus emblem. It was destitute of all ornament or engraving, but presented the outline of the winged Scarabæus, in the form of which it would have been fashioned had the mummy been of the first class, such a Scarabæus being an emblem of immortality among the Egyptians. The date of this mummy must be placed not later than 600 or 700 B.C. It became of interest to ascertain the nature of the metal of which the small plate was composed. On making a qualitative testing of a small fragment it proved to be pure tin, neither lead nor silver being detected. As sufficient material for a complete analysis could not be appropriated, an exact determination of the specific gravity of the specimen was made. The figure thus obtained was 7·369 at 16° C., a number very near that of pure tin, namely 7·29 to 7·373.

In the British Museum, the Louvre, and the Egyptian Museum at Turin, there are several small oblong and square plates of metal which have been likewise found in unrolling Egyptian mummies. Where labelled they are generally described as "silver," "lead," "white metal," or "mixed metal," and in most cases appear to contain, if not to consist of, lead. That the ancient Egyptians were familiar with some of the uses of tin—as in enamels and bronzes—has long been known; that they were acquainted with tin in a state of chemical purity would now seem to be established.

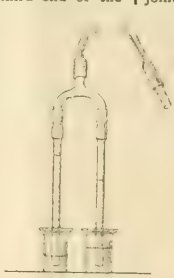
The strip of tin weighed 4·031 grms., and was about 0·3 millimetre thick, 93 m.m. in length, and 18 m.m. in breadth.

ON A SIMPLE SPECIFIC GRAVITY APPARATUS FOR LIQUIDS.

By JAMES TAYLOR.

IT is often desirable to ascertain approximately the specific gravity of a liquid in cases where the hydrometer and specific gravity bottle are not applicable, or would take up too much time. The following contrivance answers very well for this purpose, is very readily applied, even with tolerably small quantities of liquid, and easily gives results correct to the first decimal place.

Two straight pieces of glass tubing, 5 to 10 m.m. bore and 250 m.m. long, are joined by caoutchouc tubing to two ends of a T-joint which have been bent so as to be parallel. The third end of the T-joint has a piece of



caoutchouc tubing of convenient length slipped on, and this is stoppered by means of a bit of glass rod. Two small beakers, a rule, and any convenient stand arranged so as to hold the long tubes vertically, complete the apparatus.

Its application is almost obvious. On pouring a little distilled water into one beaker, and the liquid whose specific gravity is to be determined into the other, bringing the beakers under the two vertical tubes so as to immerse the ends of the latter in the respective liquids, and partially exhausting above, the liquids will rise to heights depending on their relative densities. The plug is now inserted, the lengths of the liquid columns are measured, and the specific gravity required is obtained by dividing the length of the water-column by that of the other.

Metallurgical Laboratory, Owens College,
September 29, 1877.

Novel Method of Preparing Oxygen.—Sylvester Zinno.—The author finds that oxygen may be very readily obtained even at common temperatures by the mutual reaction of two oxygenated compounds formed of several atoms of oxygen, *i.e.*, hypochlorate of lime and peroxide of barium. These facts prove, he considers, that the oxygen is produced by the neutralisation of the opposite electric polarities of the oxygen in one of the compounds and that in the other.—*Les Mondes.*

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A W. HOFMANN.

(Continued from p. 164.)

Nitric Acid and its Salts. By Dr. Adolph Geyger, of Berlin.

The hypothesis of C. Nollner† possesses the greatest amount of probability. He believes that in consequence of storms prodigious masses of seaweed, all nitrogenous, have been driven into that bay of South America, and have given rise to nitrate of soda by a process of slow oxidation.

In support of his view Nöllner adduces the constant occurrence of iodine in the nitrates, and concludes, therefore, that their origin can be due only to seaweeds, those nitrogenous collectors of oceanic iodine. The geographical position of the saltpetre beds agrees, in fact, very well with this theory, since on this coast west winds blowing from the sea predominate, their action being supported by the currents flowing along the coast. If these westerly winds only a few times in the course of centuries became violent hurricanes, and threw colossal masses of seaweeds collected from the enormous surface of the Pacific upon the land, which is entirely rainless, and consists of a parched-up plain or of a hilly alluvium, a zone of seaweeds would be formed exactly as represented by the nitre-beds of Peru. We should, of course, have to assume that the nitre when formed was withdrawn from the action of the waves by volcanic elevation or by the retrocession of the sea. The small percentage of potassium in Chilian nitre corresponds with the proportion of potash in the seaweeds, and the constant occurrence of boro-sodio-calcite reminds us of the boriferous minerals in rock-salt and in deposits of potassium chloride.

Nitrate of Potash.—For the manufacture of gunpowder nitrate of soda is not adapted on account of its hygroscopic nature. For this purpose it must be transformed into potash saltpetre. Hence large establishments have latterly sprung up for the manufacture of what is called, in contradistinction to the natural article, "converted saltpetre."

The industrial preparation of this converted nitre seems to have been undertaken almost simultaneously by Wöllner,‡ Grüneberg,§ and Nöllner‖ about 1855, when a considerable demand for saltpetre suddenly sprung up in consequence of the Crimean war. Up to that date India and the native nitre-beds had supplied all that was required by the powder works. The importation of Indian saltpetre has latterly declined, and the manufacture of native saltpetre has come entirely to an end in England, France, and Germany, and is only now carried on upon a small scale in Sweden, Russia, and Spain.

The method now almost exclusively adopted for the production of converted saltpetre depends on the double decomposition of nitrate of soda and chloride of potassium, so as to yield nitrate of potash and chloride of sodium. Since the discovery and working of the deposits of potassium salts at Stassfurt the chloride of potassium is not merely the cheapest source of potash, but admits of the most complete decomposition.

As early as 1858 Anthon¶ published a practical process for the manufacture of potash saltpetre from Chilian nitre and potassium chloride. In 1859 Kuhlmann** reconsidered this method of manufacture, with especial regard to French requirements, and Walti† proposed to use the mother-liquor of brine-springs or of sea-water, containing chloride of potassium, in the preparation of saltpetre.

A full description of the method of manufacturing converted saltpetre, as used in England in 1866, has been published by Lunge.‡‡ Equivalent weights of Chili nitre and Stassfurt potassium chloride—whose composition has previously been determined by analysis—are dissolved in water in large iron pans, and heated to a boil by the direct introduction of steam. The lye after settling is allowed to cool whilst constantly stirred, when the potash saltpetre is deposited as a fine crystalline meal, which is placed in wooden troughs lined with lead, and washed with water till a sample on being tested with chloride of silver contains only $\frac{1}{10}$ per cent chloride of sodium. When the washing is completed the still adherent mother-liquor is removed by means of centrifugals, and the saltpetre is then dried upon wooden surfaces in heated rooms. The mother-liquors are concentrated over an open fire, when the bulk of the common salt is deposited and "fished out," whilst the liquid on cooling yields a further quantity of pulverulent saltpetre. In another establishment a solution of potassium chloride is first prepared of specific gravity 1·200 to 1·210: in this the equivalent weight of Chili saltpetre is dissolved, and the solution is then concentrated over an open fire. The common salt which continually separates out is withdrawn, drained, and washed with water as long as it retains $\frac{1}{2}$ per cent saltpetre, the washings being returned to the pan. When the lye is concentrated to specific gravity 1·500 it is allowed to settle for a short time, when the common salt, as deposited, carries with it all dirt, and the clear solution is run into the crystallisers. By means of occasional agitation the crystals are obtained as fine as those of Epsom salt: the mother-liquor is drawn off, and the crystals allowed to drain perfectly. They are then covered with cold water; after seven to eight hours the liquid is again drawn off, and after the crystals have drained for twelve hours more water is poured on. This washing process is repeated till the desired purity is reached, which is generally the case after the second washing.

The author saw, in 1869, in a Scotch manufactory, this method so modified that the dry salts, chloride of potassium, and Chili saltpetre, in equivalent proportions, were mixed and heated with a quantity of mother-liquor insufficient for complete solution. The operation was carried on in a number of iron cylinders, not very large, fitted with mechanical agitators, and heated with steam-jackets. The abundant aqueous vapours evolved were conducted through a lateral flue into the chimney of the works. After agitation for several hours, during which time the loss due to evaporation is constantly made up by fresh supplies of mother-liquor, the transformation is complete, the liquid contains the whole of the nitrate of potash in solution, and the solid salt consists of fine crystals of chloride of sodium. From the solution, clarified by settling, pulverulent saltpetre is obtained by disturbed crystallisation, and freed by washing from adherent chloride of sodium. The salt is also washed in a similar manner till free from saltpetre. The mother-liquors and washing-waters are used in the treatment of fresh quantities of Chili saltpetre and chloride of potassium, and with careful working are said to be completely used up.

Other methods for the industrial conversion of sodium nitrate into potassium nitrate are probably no longer in use. In an early process the potash salts from the manufacture of beet-root sugar were utilised. The aqueous solution contains principally potassium sulphate, chloride, and carbonate, and sodium carbonate. On concentration

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* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† C. Nöllner, *Journ. Prakt. Chemie*, cii., 459; *Wagner Jahresber.* 1868, 290.

‡ Wullner, *Polyt. Notizbl.*, 1860, 49; *Wagner Jahresber.*, 1860, 204. H. Grüneberg, *Wagner Jahresber.*, 1869, 208.

§ H. Grüneberg, *Polyt. Notizbl.*, 1868, 968; *Wagner Jahresber.*, 1868, 288.

‖ Nöllner, *Polyt. Notizbl.*, 1867, 370.

¶ Anthon, *Dingler*, cxlix., 39; *Chem. Centralblatt*, 1858, 560; *Wagner*, 1858, 154.

** Kuhlmann, *Bull. Soc. d'Encouregement*, 1859, 567; *Wagner*, 1859 182.

†† Walti, *Polyt. Central.*, 1859, 129; *Wagner*, 1859, 182.

‡‡ Lunge, *Dingler*, clxxxii., 385; *Wagner*, 1866, 223.

to specific gravity 1·38 (40° B.) the sulphate of potash separates out whilst the liquid is hot, and the greater part of the chloride on cooling. The mother liquor separated from these salts was mixed with Chili saltpetre and concentrated further, when carbonate of soda mixed with more or less chloride of sodium was deposited and fished out. The clear mother-liquid on cooling deposited potash saltpetre in crystals.

Another method, proposed by Landmann,* was in use for some time in England, and was also employed by Nöllner† at Billwerder, near Hamburg, at the time of the Crimean war. It depends on the decomposition of caustic potash and Chili saltpetre, yielding caustic soda and potash saltpetre. The latter is crystallised out, and the former evaporated down, and sold as lump caustic soda. According to an account by G. A. Scherf‡ the following rather circumstantial process is used in America for the simultaneous production of potash saltpetre and baryta-white, by reason of the heavy duty on salt and the high price of hydrochloric acid. Chili saltpetre is converted by chloride of barium into nitrate of barium and chloride of sodium. Stassfurt chloride of potassium is converted into sulphate of potassium and hydrochloric acid by heating with sulphuric acid, and the sulphate of potassium thus obtained is finally converted by treatment with the barium nitrate into potash saltpetre and baryta-whfte.

We have still to mention Delafield's§ proposal for the simultaneous manufacture of white-lead and potash saltpetre. He precipitates a boiling solution of nitrate of lead with carbonate of potash, when a carbonate of lead, agreeing in composition and properties with white-lead, is thrown down, whilst potash saltpetre remains in solution, and may be obtained by concentration.

In the technological analysis of nitrate of potash the chlorine is generally determined volumetrically by means of silver nitrate, with chromate of potash as indicator; the sulphuric acid gravimetrically as barium sulphate; the potassium as the double platino-chloride, and the water and insoluble constituents by direct weighing. From these data the composition is calculated. A special examination must be made for sodium nitrate. This is most conveniently carried out according to the proposal of Nöllner,‖ by moistening a portion of the sample—not too small—with a little water, evaporating the solution to dryness, moistening the saline residue again, and re-evaporating the lixivium. The whole amount of the very soluble soda saltpetre may be in this manner collected in a very small quantity of liquid, so that it may be easily recognised by its rhombohedral crystalline form, and especially by its characteristic optical behaviour under the microscope with the polarising apparatus. If it is desired to determine the nitric acid, this is for technological purposes best effected by mixing the sample intimately with sugar, graphite,¶ or oxalic acid, and igniting after the addition of from 4 to 6 parts of common salt. The fused mass is lixiviated with water, and the carbonate formed is determined volumetrically with normal sulphuric acid, from which the nitrate is easily calculated. A number of other methods have been proposed, which in experienced hands give accurate results, but which are either too circumstantial for practical use, or without due care may easily lead to serious errors.

The applications of potash saltpetre in the manufacture of gunpowder, and of the nitrates in fireworks, are known. Latterly, Chili saltpetre has been used according to the suggestion of Knowles, made as early as 1858,** by Hargreaves,†† Heaton,‡‡ and Bessemer,§§ for the decarbonisation of cast-iron in the manufacture of steel, and, according to the opinion of Schinz* and Gruner,† has given satisfactory results. R. Wagner,‡ calls attention to the applicability of nitrate of soda in the metallurgy of copper and nickel, for the removal of sulphur from the concentrated ores, and of arsenic from the nickel speiss.

Nitric Acid.—In the industrial preparation of nitric acid Chili saltpetre and common sulphuric acid are exclusively used, and none of the numerous proposals for obtaining it in any other manner have been carried out on the large scale. The respective proportions of sulphuric acid and of soda saltpetre are not alike in all manufactories, some using but little more sulphuric acid than the equivalent of the nitre, whilst others to 1 equivalent of nitre take as much as 1½ equivalent of sulphuric acid. In the former case the residual sulphate is very sparingly mobile, and must be taken out of the retorts in lumps when cold. In the latter case the bisulphate formed reduces the melting-point of the residue so far that it can be easily run off in a liquid state.

(To be continued.)

* Landmann, *Dingler*, cxvii ,78. † Nöllner, *Polyt. Notizbl.*, 1857, 170.
‡ Scherf, *Wagner*, 1867, 227.
§ Delafield, Chem. News, 1866, xiv., 178.
‖ Nöllner, *Polyt. Notizbl.*, 1857, 301; *Dingler*, clxxxvi., 333; *Wagner*, 1867, 241.
¶ Abel and Bloxam, *Chem. Soc. Quarterly Journal*, x., 169.
** Knowles, *Repert. Patent Inv.*, 1858, 234; *Dingler*, clix., 317; *Wagner*, 1858, 14.
†† Hargreave, *Mech. Mag.*, 1865, 11, 501; *Dingler*, clxxxvii., 480; *Wagner*, 1865, 54.
‡‡ Heaton, *Dingler*, clxxxvi., 499; *Wagner*, 1868, 87.
§§ Bessemer, *Prakt. Mech. Journ.*, 1868, 143; *Dingler*, cxc., 32; *Wagner*, 1868, 88.

ON A PROCESS FOR THE ELECTRICAL DEPOSITION OF METALS, AND FOR CONSTRUCTING METAL-COVERED GLASS SPECULA.§

By Prof. ARTHUR W. WRIGHT, Yale College.

In a paper by the writer, published in the *American Journal of Science and Arts*, January, 1877, an account was given of a method of producing metallic films upon the inner surface of exhausted glass tubes, by the action of a succession of energetic electrical discharges. The thickness of these films could be varied, from a tenuity such that the coating barely gave indications of a metallic lustre, and scarcely dimmed the intensity of transmitted light, to the point where perfect opacity was attained, by simply continuing the action of the current for a shorter or longer time. They were produced by forming the negative electrode of the metal to be deposited, exhausting the tube, and passing through it the current from an induction coil. The metallic coatings thus obtained, as seen from the exterior, were very brilliant, but the condition of the inner surface was not readily observed, and the nature of the process made it seem probable that they possessed a dull or even frosted surface. With a view to obtain the films in a form better suited for examination, a modification of the apparatus was contrived, by which they could be deposited upon pieces of plane glass. At first this object was attained by inserting narrow slips of glass into the tube by the side of the electrode, in the manner suggested in my former paper, and very good results were gained. But, as the nearer portion of the plate received a larger share of the metal, the thickness of the deposit was not uniform, and it was found necessary to construct a special apparatus, in which the relative positions of the plate and the electrode could be varied, so as to give the latter an equal action upon all parts of the surface to be covered. The plan employed was as described in the following paragraphs.

A rather thick-walled glass globe, about 7 centimetres in diameter, blown upon the end of a tube 25 centimetres long and 15 m.m. in diameter, was used to form the receiver. The top of the globe opposite the tube was cut off, so as to form an opening 40 m.m. in diameter, and the edge ground flat, in a plane perpendicular to the axis of the tube. The end of the latter was drawn somewhat

§ From the *American Journal of Science and Arts*, vol. xiv., September, 1877.

smaller in a gas-flame, and a glass stop-cock attached to it with cement. A little way above this, a platinum wire was fused into the glass to serve as the positive electrode. The cover of the vessel was made by cutting from a similar globe a portion corresponding in size to the part removed, but with the neck attached, the two pieces being carefully ground so as to fit closely. When they were placed together a little cement applied to the outside along the line of juncture rendered the joint perfectly air-tight. The tube or neck of the cover was 5 centimetres long, and was also somewhat reduced at the extremity by drawing it smaller. Into this was cemented a small and thick-walled tube, extending to a point near the centre of the globe. A platinum wire was placed in this tube, and was fused in at the top, enough being left projecting to form a small loop for the attachment of the wire from the coil. The inner end of the wire terminated at about 1 centimetre from the lower end of the glass tube. Into the latter was slipped a wire of the metal to be deposited, which, in all cases, was the negative electrode—the part within the tube being long enough to make good contact with the platinum wire, and being bent somewhat so as to cause it to retain its place by friction. In some of the experiments a different cover was used, made from a glass funnel, the neck of which was left somewhat longer to afford more room for the swinging electrode, as described below, and the tube carrying the latter was fitted into the top by grinding so as to make an air-tight joint.

For the support of the plate a small watch-glass, about 3 centimetres in diameter, was employed, to one edge of which a thread of glass was fused by a blowpipe flame, and then bent so as to form a loop by which it could be suspended like the pan of a balance. A small hook of glass was also attached to the side of the thick tube carrying the electrode, and upon this the pan was hung, the loop being so formed as to allow it to swing freely in all directions. The pan, when in place, was about 15 m.m. below the end of the tube from which the electrode projected, the latter being adjusted to the proper distance by sliding it up or down in its support as occasion required. By slightly inclining the globe the extremity of the wire could thus be readily brought over any point of the plate. In some of the experiments the plate was stationary, being held in a little tripod of glass threads, or simply laid upon the bottom of the globe. In these cases the tube holding the electrode was jointed near the top, the two portions being connected by a hook and loop of platinum or magnesium wire. It could thus be made to traverse all parts of the plate by giving suitable movements to the globe.

When adjusted and closed the receiver was attached to the Sprengel pump. By means of a small air-pump of the ordinary construction, connected with this by a stop-cock and flexible tube, the whole apparatus was exhausted as far as possible and then dry hydrogen admitted, this being repeated two or three times in order to remove the air and moisture. The process of exhaustion was then completed with the mercury pump. The degree of rarefaction required varied somewhat with the metal to be deposited, but was rarely above 2·5 m.m. For platinum the best results were obtained, when it was from 1·5 to 1·75 m.m. The use of hydrogen is not in all cases necessary, as some of the metals can be deposited perfectly well with only air in the receiver. This is especially the case with gold, but platinum, although ordinarily not easily combined with oxygen, becomes tarnished with a film of what apparently is the blue oxide, unless the air is removed. The electrode itself was formed of a small wire, usually not more than one-fourth of a millimetre in thickness, bent at the end into a circle 3 or 4 m.m. in diameter, the plane of which was perpendicular to the straight portion of the wire entering the glass tube, and parallel with the surface of the glass plate situated beneath it. Its distance from the latter was generally about 3 m.m., though considerable variations were possible. When it is farther away the process of deposition goes on much more slowly, though the results are in most cases quite as good as when it is nearer. After the process of exhaustion was completed, the stop-cock was closed, and the apparatus removed from the pump, for greater convenience of manipulation in applying the current.

The electrical apparatus employed consisted of an induction-coil capable of giving sparks 4 or 4 centimetres in length, and a battery, the power of which could be varied according to circumstances. It consisted usually of pint Grove cells, from three to six in number, not completely filled, or charged with rather weak acid, and a plunge battery of five cells, of which one, two, or more were used, as occasion required, the whole being joined in a continuous circuit. By immersing the plates of the plunge battery more or less, as well as by varying the number in the circuit, the strength of the current could readily be changed within the limits desired. The various metals required currents of different strength, and the power best suited to each had to be determined by trial. It was found advisable in most cases to regulate it so that the temperature of the electrode was below that of a red heat, or such as barely to redden it. Of course with the more fusible metals it was necessarily much lower than this. The metal is actually volatilised by the discharge, as is shown by the fact that the characteristic lines of its spectrum may be seen with a spectroscope, and the film is formed by the condensation of its vapour upon the cooler glass surface. For the production of films with brilliant surfaces, the strength of the current must not be great enough to give the discharge a disruptive character, as this separates some of the metal in the form of powder.

The primary object of the experiments was to obtain films of the different metals upon thin pieces of flat glass for the purpose of investigating some of their optical characters. The apparatus proved to be perfectly successful in its operation, and beautiful films of gold, silver, platinum, and bismuth, were obtained with ease and certainty. As has been mentioned, it seemed probable that the surface of deposit would be dull, but the first trial showed that this anticipation was incorrect, and the films when removed from the receiver exhibited surfaces of exquisite perfection and the most brilliant polish. They can only be compared to the surface of clean liquid mercury, far surpassing in lustre anything that can be obtained by the ordinary methods of polishing.

This circumstance suggested at once a valuable application of the process in the production of specula for optical purposes, and the subsequent investigations were directed to this end. The mirrors first made had been formed upon disks of thin glass, such as are commonly used as covers for microscopical objects, those being selected which were most free from defects, and had the best surfaces. By means of a very delicate assay balance, the weight of the glass disks, both before and after receiving the deposit, could be obtained to the one-hundredth part of a milligrm., and hence it was easy to calculate the thickness of the metallic layer in any instance. By this means the relative transparency of the different metals can be determined, and the relation between the amount of light transmitted and the thickness of metal traversed by it. The more particular consideration of these and some other matters of interest as bearing upon the optical characteristics of the metals is deferred to another time, and it is only necessary to mention here the results of some measurements which were made in order to determine the limiting thickness of a film in regard to the transmission of light, that is, the thickness of a film which would allow only an inconsiderable proportion of the incident rays to pass through. As the metallic lustre is developed gradually with the increasing amount of metal, showing conclusively that light actually penetrates these substances to a certain depth, it was important to ascertain whether the thickness of the layer, sufficient for a virtually complete reflection of light, would be great enough to affect perceptibly the figure of a mirror of glass upon which it was laid down.

Experiments for this purpose were made with gold and platinum, and the process of deposition was continued until the films appeared to have just reached the condition of complete opacity. On removing them from the receiver, however, it was found in both cases that a very small amount of light was still transmitted, as, on holding them close to the eye, a brilliant object, like the sun or a bright flame, could be seen through them. The thickness of the gold layer was found to be 0·000183 m.m., that of the platinum 0·000174 m.m., or approximately one-fourth the length of a wave of light at the red end of the spectrum. The gold, although thicker than the platinum, transmits perceptibly more light, showing that it is the more transparent of the two metals. As the films employed for mirrors may be much thinner than the amount mentioned without an appreciable diminution of the intensity of reflected light, it is evident that the figure of a perfectly wrought-glass mirror will not be changed, when the metal is uniformly deposited, to such an extent as to affect its performance unfavourably. A platinum film of one-fifth the thickness of the one described forms a brilliant mirror, transmitting but a very small percentage of light. The perfect control of the process obtained by the use of the movable electrode will even make it possible to apply the method of local correction for the improvement of a defective figure, or to parabolise a spherical mirror by depositing the metal in a layer increasing in thickness toward the centre, though, of course, it would be better to avoid a somewhat tedious operation by securing the perfect form of the glass beforehand.

Of the metals that are suitable for the formation of specula, platinum appears to be the most valuable. For while, when well polished, it is but little inferior to silver in reflecting power and freedom from colour, it does not become tarnished by oxidation or the action of sulphurous gases, and when dulled by atmospheric deposits the surface can be cleaned by washing with water or with acids, which is an important advantage. By the method here described it can be deposited upon glass surfaces very easily, and a mirror of the most perfect surface produced at once, without the necessity of a single touch, to complete it. Several such mirrors have been made in the course of these experiments, by the use of concave glass lenses, with the most satisfactory results. The metal film adheres strongly to the glass, and when of sufficient thickness appears to be very firm and hard. In mirrors silvered by the ordinary method, trouble is often experienced from the insinuation of moisture between the glass and the metal, resulting finally in the separation of the latter. In those prepared by the new process the adherence of the film is so close as to render such an effect impossible. As a test of this, a small silvered speculum was placed in a beaker of water where it remained for two weeks, and besides this was wetted and dried repeatedly, without showing the slightest tendency to suffer the penetration of the moisture. Similar results were also obtained with platinum and gold films.

With silver the process likewise succeeds well, but it is more difficult to obtain good surfaces than with gold or platinum. The metal is volatilised with extreme ease by the action of the current, and the energy of the discharges must not be too great. Of several trials made with this metal the most successful was one in which not only the degree of exhaustion of the receiver was less than had been employed in other cases, being only to 3 m.m., but the electrode was more distant from the plate, and the battery weaker. The action proceeded slowly in this instance, but with the result of producing an excellent film. With a stronger current the deposit is rapidly made, and has a fine lustre, but the surface has a yellowish colour. This is perhaps partially due to a slight degree of oxidation, but also appears to be owing in part to the deposition of a portion of the metal in the form of fine powder, the vapour of the silver as it streams from the electrode toward the more distant portions of the plate becoming partially condensed, and falling on it in minute particles. That such a result would follow from this cause was shown by some of the experiments in which a rather strong battery was employed. The whole interior surface of the globe was in a short time covered with the powdered metal, appearing an intense purple where thinnest, and shading gradually to deep blue where thickest, the colour being the same by both transmitted and reflected light. The metallic lustre was wanting, though it was readily developed when a portion of the powdery coating, which was easily removed, was rubbed against the surface of the glass with some pressure. The defect was, to a considerable extent, remedied by surrounding the electrode with a small glass tube projecting some 3 m.m. beyond it, so as to clear the surface of the plate by an interval of only 1 or 2 m.m. This had the effect to cut off the lateral portion of the discharge, and to confine its action to a limited area immediately below the extremity of the wire.

The yellow tarnish is removed with the greatest ease by gently rubbing the surface with soft chamois leather and a little rouge, and the metal is so hard that when this operation is performed with care the polish is not at all, or but very slightly, affected. Even then, however, the metal is not perfectly white, having still a very faint yellow tinge. It is well known that silver is not a perfectly white metal, for light which has undergone repeated reflections from polished surfaces of this metal appears yellow or reddish yellow, though this colour is not perceptible when the light has undergone but a single reflection. But the real cause of the yellowish tint may possibly be found in the very tenuity of the films, which when prepared in this way have a beautiful and intense blue colour by transmitted light. When not too thick, the amount of blue rays which they suffer to pass may be sufficient to cause, by their abstraction, a perceptible tinge of yellow, the complementary colour, in the reflected rays. If this were really the case the colouration should grow weaker with an increase of thickness, and disappear when opacity is reached. Some of the results obtained seem to favour this view, and the probability of its correctness is strengthened by the facts related in the next paragraph, but further experiments are needed to decide the question satisfactorily.

One result of the investigation has been to show that the colour of the light which has passed through a layer of metal varies somewhat with the thickness of the film. This was known to be the case with gold, and experiment has shown it to be true of platinum and bismuth also. Thus the latter in a very thin film appears a clear bluish-gray, while a much thicker film appears brownish. Platinum in a thin layer has a greyish tint, which varies, as the film is made thicker, to a peculiar brownish shade, somewhat like that of sepia, passing into brownish yellow, and finally becoming a deep yellow, even inclining somewhat to orange in the thickest films obtained. Now this colour is almost exactly complementary to that transmitted by silver, and the possibility suggested itself of making a mirror which should be perfectly white by reflected light, by depositing first a thin stratum of silver and over this another of platinum, the relative thickness of the two being properly regulated by observing the colour of the transmitted light. An experiment made with a circular disk of flat glass was perfectly successful, the platinum being readily deposited upon the silver, the yellowish tint of which it entirely removed, producing a white and brilliant reflecting surface. By transmitted light the film, as it was anticipated would be the case, has a pure neutral tint, with no perceptible colour of any kind.

The value of such a combination for specula is evident, for though until careful measurements are made, it cannot be asserted that the absolute reflecting power is increased, the whiteness of the layer and the protection afforded by having the surface covered with an unalterable metal, are very substantial advantages. In constructing large mirrors it will probably also be found to result in a material saving of time, the silver being so much more

rapidly and easily deposited than the platinum. The process can also be used with great advantage for the construction of solar eye-pieces for telescopes, since the compound film can be deposited directly upon the surface of the lens, and made thick enough to reduce the intensity of the light as much as may be desired. An image nearly or quite colourless could thus be obtained, and the disturbance of the rays should be less than that produced by the interposition of a dark glass of the ordinary kind.

As has been mentioned, some experiments were made with bismuth, and a mirror of excellent surface was obtained, but the metal is inferior to platinum in brilliancy, and has a decided colour. The great facility with which films are obtained with it might recommend its use for mirrors in some cases, but for most purposes other metals are to be preferred. Attempts to produce mirrors of iron and nickel were but partially successful, as it was difficult to prevent tarnishing by oxidation. Some good iron films were obtained, however, which were very brilliant. They were exceedingly hard, and adhered to the glass with such tenacity that at first it seemed as if they had been fused into it. But when the film was dissolved off by an acid the glass was found not to have been acted upon at all. A singular characteristic of the iron in this condition is its chemical inertness. Films prepared more than six months ago and freely exposed to the air, which, for a part of the time too, was excessively charged with moisture, have not shown the least alteration. Nitric acid placed upon one of them for a short time produced scarcely any effect, and nitro-hydrochloric acid acted upon it with about the same readiness as it does upon platinum. This may be due to the extreme thinness of the film, in consequence of which, even the exterior atoms of the iron, being within the range of the molecular action of the glass, are held by a force tending to oppose and neutralise the attraction of reagents that ordinarily attack the metal energetically.

It is not at all necessary that the object upon which the metal is deposited should be of non-conducting material. This is shown by the fact that the process continues to go on after the glass has become covered with a perfectly continuous layer of metal of considerable thickness. The success of the experiment of covering a silvered glass with platinum is additional evidence of the same fact. In order more fully to test the question whether a deposit could be made upon a solid piece of metal, a small silver coin was placed in the pan under an electrode of gold. It was covered in a few minutes with a beautiful coating of the latter metal, which was found to be very hard and to adhere perfectly, having also, in every respect, its proper colour and lustre. At the beginning of the process, while still thin enough to allow light reflected from the silver to pass, it had a greenish colour, producing a curious effect.

As an example of the applicability of the process to practical purposes, it may be of interest to mention the results of some experiments in the construction of a small Gregorian telescope, the specula of which were covered with platinum by the method described, and with entire success. The larger mirror has a diameter of a little less than 4 centimetres, and both this and the smaller one, so far as the nature of the surface is concerned, appear absolutely faultless. As only common lenses were employed in its construction the performance of the instrument is not remarkable, but it is sufficiently good to warrant the assurance that the method will be serviceable for the production of specula of exquisite quality for optical purposes. The size of the apparatus, which, for convenience in experimenting, was necessarily small, did not permit the introduction of larger mirrors than this, but there seems to be no reason for doubting that much larger specula can be successfully made in this way. The amount of time required for obtaining the platinum covering of this mirror was about three hours, during which the coil was kept in continuous action, with a battery power equivalent to four or five small Grove cells. Mirrors of larger size would of course require a longer time, but with suitable apparatus a much stronger battery and larger coil could be used, which would materially accelerate the operation. A plate 2 centimetres in diameter can be covered with platinum in twenty or thirty minutes sufficiently thick to form a good speculum. For gold or silver the time would not be more than from ten to fifteen minutes.

Many useful applications of this process may be found, and its use is not limited to those metals which have been mentioned here. Moreover, for many of them no other available process is known by which they can be deposited in a uniform layer and with a brilliant reflecting surface upon glass. A very thin layer of platinum, or still better of silver and platinum together, could be used with great advantage in the *camera lucida* and similar instruments. Very perfect mirrors for galvanometer needles, and for delicate torsion apparatus, can be expeditiously formed in this way, and by the use of very thin glass, or the most delicate films of mica, they may be made of almost inappreciable weight. For the mirrors of heliostats, and other reflecting instruments in which a metallic surface is necessary, the specula produced by this method will be especially valuable. For telescopes, the beautiful process of Liebig and Foucault, for forming silvered glass specula, is recommended by the ease with which it is applied, and the rapidity of its operation. But the perishable nature of the delicate silver film, and the difficulty of securing a firm and permanent adherence, are serious disadvantages. These are entirely avoided by the use of an unalterable metal like platinum; and though for instruments of the largest size the process here described may be found impracticable, for those of more moderate dimensions there is every reason for believing it may be employed with complete success. The labour and time required for its application are indeed drawbacks; but there is compensation for this in the important circumstance that the mirror comes out of the receiver with a surface of inimitable perfection, which would in fact only be injured by any of the ordinary methods of polishing.

Yale College, August 8, 1877.

CORRESPONDENCE.

THE READY COMBUSTIBILITY OF MANGANESE SULPHIDE.

To the Editor of the Chemical News.

SIR,—Since I sent you the communication which appeared in the CHEMICAL NEWS (vol. xxxvi., p. 113) "On the Action of Alkali-waste on Manganese Chloride, and the Spontaneous Ignition of Manganese Sulphide," I have found that I was not the first to notice this property of manganese sulphide, but that it has been observed still earlier by Dr. R. Angus Smith, F.R.S. This notice would have been forwarded sooner but for the intervention of a variety of circumstances which prevented my writing it.—I am, &c.,

WATSON SMITH, F.C.S.

Akademie Strasse, Heidelberg,
October 6, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 13, Sept. 24, 1877.

This issue is entirely taken up with the orations delivered on occasion of the death of M. Leverrier.

Moniteur Scientifique Quesneville.
October, 1877.

Researches on the Substances of the Anthraquinon Group.—MM. E. Schunck and H. Roemer.—These researches have been published eighteen months ago in the *Berichte der Deutschen Chem. Gesell.*, and in the *Memoirs of the Philosophical Society of Manchester*. Three notes, treating respectively of the derivatives of naphthalin, of normal propyl-benzin and propyl-phenol, and of propyl-iso-propyl-benzin and the propyl-benzoic and homoterephthalic acids are taken from back issues of the *Gazzetta Chimica Italiana*.

Theory of Colours applied to the Arts and to Industry.—This is a notice of a work by Prof. Bezold of the Polytechnic School of Munich, an English edition of which has been brought out in America. The author objects to Chevreul's arrangement of colours, and maintains that the principle of the chromatic colour does not agree with the laws of the mixture of colours. "In fact the admixture of black is equivalent to a decrease of intensity, for the abated colours obtained by this mixture may also be obtained by illuminating more and more feebly a surface painted with a pure colour. We know that when the day declines all colours darken and become converted into black. But, on the other hand, an admixture of white is not equivalent to an augmentation of intensity, for the whitened colours are not pure colours intensified; they are colours imperfectly saturated. M. Chevreul confounds under the name of "ton" two modifications essentially distinct. The chromatic circle also does not contain the gamut of white, *i.e.*, the series of grey shades which represent the mixtures of white and black, nor do we find in it the mixtures of the colours with white and black at once. An attempt has been made to correct this imperfection of the chromatic circle by adding nine chromatic circles uniformly lowered with black, but in this manner many colours are necessarily repeated several times in the successive circles." M. Bezold proposes to revert to the "chromatic cone" of Lambert, the construction of which agrees with the principles established by Helmholtz and Maxwell. On these principles every sensation of colour depends on the factors by which it is completely determined; for these we may take:—1. A pure colour defined by its wave-length (Chevreul's *nuance* and Helmholtz's *ton*). 2. The luminous intensity of this colour, which may be determined by the quantity of black to be added to the normal shade. 3. The degree of saturation or of purity, which depends on the quantity of white to be mixed with the normal colour. To obtain all the colours possible it is needful to form a chromatic circle with a certain number of distinct colours distributed on the extreme circumference, and degraded successively by admixture with growing proportions of white, to the centre which is occupied by white. We then form a similar series of circles by successively diminishing the luminous intensity of the colours contained in the first by an admixture of black. For the colours to be placed on the circumference of the circle M. Bezold takes in the outset the following ten, which form five pairs of complementary colours:—Red and green-blue; orange and blue; yellow and ultramarine; yellow-green and violet; green and purple. The wave-lengths of the two complementary colours are to each other about 4 to 5; but we remark that the purple, a compound colour not existing in the spectrum, is not defined by its wave-length. M. Bezold admits that the difference between the yellow-green, the green, and the blue-green is much less sensible than that which exists between their complementary colours, violet and purple, or purple and red. He therefore subdivides the violet into blue-violet and purple-violet, and the red into carmine and scarlet, thus obtaining a scale of twelve equidistant colours.

Protection of Inventions in Science and Industry.—M. A. Lermite.—An account of the Congress on Patent Right held in connection with the Vienna Exhibition. Mr. Macfie, one of the leaders of the party which in England seeks to deprive inventors of all property in their own ideas, was not personally present, but in a written communication he spoke of the "injurious activity" of inventors, and assured the Congress that a spirit hostile to patents was beginning to prevail "upon the wool-sack." (We hope that since 1873 the wool-sack and even Mr. Macfie may have learned better). His contention was annihilated by the speech of the American commissioner, the Hon. J. M. Thacker.

On Salicylic Acid and the Salicylates.—Prof. Germain Sec.—A medical essay of no especial chemical interest.

Analysis of Products containing Glucose, and Determination of Sugar in Coloured Substances.—MM. H. Pellet and L. Pasquier.—Not capable of useful abstraction.

Manufacture of Artificial Butter.—Dr. H. A. Mott. The author maintains that the product manufactured from animal fats is "as good as the greater part of butters if not equal to the best products of cream." His comparative analysis of the natural and the artificial kinds, shows, as is to be expected, a considerable difference. In genuine butter butyrine, caproine, caprine, and capryline amount to 7·606 per cent, whilst in the factitious article they only occur to the extent of 0·262 per cent.

Biedermann's Central-Blatt fur Agrikultur Chemie, Heft 8, August, 1877.

Investigations on the Propagation of Heat in the Soil by Conduction.—Dr. Emil Pott.—Quartz conducts heat best, humus and clay take an intermediate place, and carbonate of lime is the worst conductor. A dense compact soil conducts heat better than a loose soil. One and the same soil when moist conducts heat better than when dry. The influence of the thermic conductivity of a soil upon its temperature appears hitherto to have been overestimated.

Influence of Manures upon the Nature of the Seeds Produced by the Kidney-bean, Phaseolus vulgaris.—Dr. Gustav Mark.—The manures experimented with were kainit, nitrate of soda, bone dust, superphosphate, gypsum, guano, kainit and bone dust, kainit and gypsum, kainit and nitrate of soda, guano and bone dust, and farm-yard manure. One plot was left unmanured. The heaviest yield of beans was given by bone dust and the next by superphosphate. Kainit with nitrate of soda, kainit with gypsum, guano with bone dust, guano alone, and farm-yard manure gave worse results than the unmanured plot. Guano appears to have an injurious action. The nitrogenous manures increased the percentage of albumenoids; kainit favours the productions of the hydrates of carbon. The plot manured with stable-dung gave seeds of the lowest specific gravity.

Gazzetta Chimica Italiana,
Anno vii., 1877, Fas. viii. and ix.

Periclasiferous Predazzite of Monte Somma.—Prof. Alfonso Cossa.—The crystals of periclasite contain:—

Magnesia	95·39
Ferrous oxide	4·56
	99·95

The rock freed from these crystals is composed of:—

Carbonic acid	40·28
Lime	45·73
Magnesia	9·32
Ferrous oxide	0·41
Water	3·97
	99·71

Detection and Determination of Carbonic Acid.—Egidio Pollacci.—The author figures and describes a

modification of the apparatus of Kipp which he has adopted for the analysis of carbonates.

New Researches on Asparagin. J. Guareschi.—In this continuation of his researches the author examines succinamic uramidic acid, and the behaviour of sulphocarbamid with asparagin.

Penta-phenyl-chloretan and other Products of the Action of Sodium upon Tetra-chloro-methan and Mono-bromo-benzine.—J. Guareschi.—Not adapted for abstraction.

On Tribromo-acetamid.——J. Guareschi.—A reclamation of priority as to the discovery of this substance.

Furfuramid and Furfurin.—R. Schiff.—The author describes the preparation of furfuramid and furfurin, their behaviour with anhydrous acetic acid, with nitrous acid, nascent hydrogen, and the oils of mustard, and the action of bromine upon acetyl-furfurin.

Some Derivatives of Cymen.—E. Paterno and C. Colombo.—In this preliminary notice the authors speak of the mercuric compound $(C_{10}H_{13})_2Hg$, and of the sulphacid of bromo-cymen.

Temperature of Flame.—F. Rossetti.—The flame of a mixture of two volumes of coal-gas with three of carbonic acid gave a maximum heat of 1000°. One volume of coal-gas with two of carbonic acid gave 860°, whilst the maximum temperature reached with the flame of one volume of coal-gas and three of carbonic acid was 780°. Mixtures of coal-gas and atmospheric air decrease in heat if the proportion of the latter exceeds what is necessary for combustion.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

SEPTEMBER, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Clear	0·001	0·009	0·090	0·100	20·80	8·960	0·396	0·86	1·330	13·7	3·30
West Middlesex	Clear	0·000	0·009	0·111	0·048	17·30	7·280	0·320	0·86	1·200	12·6	3·00
Southwark and Vauxhall	Clear	0·002	0·010	0·118	0·110	19·70	8·400	0·430	0·79	1·200	13·2	3·30
Chelsea	Slightly turbid	0·001	0·009	0·105	0·092	21·00	8·170	0·360	0·79	1·460	14·3	3·30
Lambeth	Clear	0·001	0·009	0·130	0·079	20·70	9·080	0·399	0·91	1·330	13·7	3·00
Other Companies.												
Kent	Clear	0·000	0·002	0·268	0·010	26·60	10·860	0·930	1·44	3·530	19·4	5·10
New River	Clear	0·000	0·006	0·090	0·017	16.10	7·840	0·360	0·94	0·870	12·6	3·30
East London	Clear	0·000	0·007	0.099	0·041	20·00	7·840	0·320	0·94	1·260	12·6	3·00

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY, M.B.

MISCELLANEOUS.

American Devotion to Science.—We have repeatedly had occasion to refer to the great interest in the advancement and diffusion of science prevalent in the United States, and to the exertions in that direction made by the Federal Government, by State and Municipal authorities, and by private citizens, whose liberality in founding and endowing colleges, observatories, laboratories, &c., has been most strikingly manifest. As a further proof of this zeal for scientific education we may mention that the Massachusetts Institute of Technology has provided special laboratories for the instruction of women in chemistry—analytical, industrial, and physiological; in botany, mineralogy, microscopic manipulation, &c. To illustrate the fact that good work is done in this department, we need only refer to an excellent paper by two ladies on the determination of nickel in pyrrhotites and mattes, which is inserted in our issue for October 5.

TO CORRESPONDENTS.

J. W. McMalcolm.—Messrs. Trübner publish "A Practical Treatise on the Manufacture of Soaps," by Campbell Morfit, M.D., F.C.S. The price is £2 12s. 6d.

C. W. Eacott.—We do not know.

ERRATA.—P. 159, bottom of col. 2, *for* "*x*" *read* ×. P. 160, col. 2, lines 4 and 18 from bottom, and p. 161, col. 2, line 3 from top, *for* "m.m." *read* "millionths of a millimetre." Fig. 2 *read* "strength in grms." In figs. 3, 4, and 5 the engraver (who failed to supply the cuts until the day of publication) has omitted the absorption-bands.

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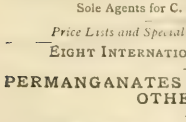

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JOHN NORMAN and CO., ENGINEERS, Glasgow, are the MAKERS of MACTEAR'S PATENT, REVOLVING CARBONATING FURNACES, which have been in use for some time, and have given great satisfaction. Can be seen at Messrs. Charles Tennant and Co.'s Chemical Works, Hebburn, Gateshead, Newcastle-on-Tyne, and at their Works, St. Rollox Glasgow.

THE CHEMICAL NEWS.

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REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By I. A. C. LOSMANN.

(Continued from p. 170.)

Nitric Acid and its Salts. By Dr. Adolph Geyger, of Berlin.

The degree of concentration of the sulphuric acid is regulated according to the strength of the nitric acid to be prepared. Ordinarily, sulphuric acid is used at specific gravity 1·718 (60° B.), as obtained by concentration in lead pans. Experience has proved that with this strength the mixture froths least, so that the retorts may be charged tolerably full. The average strength of the nitric acid thus obtained varies with the quantity of sulphuric acid used and the heat applied, but ranges in general between specific gravity 1·38 to 1·41 (40° to 42° B.). For the preparation of weaker kinds this acid is diluted with water, which is placed previously in the condensing apparatus. For stronger nitric acid a more concentrated sulphuric acid must be taken, and for nitric acid of specific gravity 1·50 to 1·53 (48° to 50° B.), which almost corresponds to the pure monohydrate, dried Chili nitre, and oil of vitriol at specific gravity 1·85 (66° B.) must be used.

The apparatus employed consists in general of horizontal cast-iron cylinders, set so that they may be enveloped as equally as possible in the hot furnace-gases. In some works an attempt is made to protect the upper half of the cylinder from corrosion by the acid by means of a lining of bricks or a coating of fire-clay. This arrangement is, however, useless if the iron is kept so hot that no nitric acid can be condensed upon it. The expedient may even have an injurious effect, since the porous mass of clay is less strongly heated than the metal, and easily retains a portion of nitric acid which, when the cylinder cools, may attack the iron. The two ends of the cylinder are not exposed to the fire, and are therefore best closed with plates of sandstone luted with a mixture of iron-filings, sal-ammoniac, sulphur, and vinegar. This luting sets rapidly, and resists the action of the fire and of the acid very well. The front end slab has in its upper half an aperture which serves for the introduction of the nitre, and can be closed with a stone stopper luted with clay. In this stopper is a smaller orifice, through which, when everything else is arranged, the sulphuric acid is run in by means of a lead pipe. At the lower part of the front of the cylinder there is a concavity with a hole 8 centims. in diameter, through which the liquid sulphate of soda is removed at the end of the operation. During the process this hole is closed with a cast-iron stopper luted with clay. The back stone slab is perforated to receive a fire-clay pipe, which connects the interior of the cylinder with a series of stoneware jars which serve as condensers. The uncondensed gases are passed into a coke-tower, where they encounter a descending shower of water, which condenses the last traces of nitric acid, and with the joint action of air converts into nitric acid any hyponitric acid present. The stoneware vessels (*bombonnes*) are generally of the same form as those used for hydrochloric acid. Each has two wide apertures for the connecting pipes, and a smaller one for drawing off the acid.

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

Devers and Plisson* have modified the form of the condensing apparatus, so that two jars are placed one above the other in such a manner that the upper is fitted like a funnel into the middle aperture of the lower. The acid as it condenses flows into the lower jar, and from there through a syphon luted in, to a large receiver. At the end of the condensing plant there are still several jars placed upon each other, and filled with fragments of pumice in which the hyponitric acid is condensed by a current of water. If about equal equivalents of sulphuric acid and nitre are used, the residual sulphate of soda, as has been already mentioned, is not sufficiently mobile to flow out. The front end of the cylinder is then closed with a cast-iron plate, protected within by a lining of clay. The plate is luted with a mixture of clay and horse-dung, as the iron-lute mentioned above sets too hard. Before charging the cylinder some prismatic bars of cast-iron with sharp edges are laid at the bottom. On these the cake of sodium sulphate breaks as it cools, and can thus be easily taken out in pieces.

Instead of the cylinders many manufacturers use cast-iron troughs, whose sides are lined with sandstone plates, or with blocks of stone, and which are closed above with a sandstone slab or with a double arch. This arrangement is less advantageous, the outlay in fuel is greater, and the apparatus itself is more readily corroded by the acid.

A preferable construction is a large cast-iron boiler, with a wide aperture above for the introduction of nitre and sulphuric acid, and closed during firing with a cast-iron lid. The boiler is set so as to be exposed to the flames all around and even above the lid. The nitric acid is led to the condensers by a neck cast on to the boiler, and lined with a stoneware pipe as a protection against the action of the acid. The soda sulphate is run out through a pipe cast at the bottom of the boiler. The liquid sulphate is best received in iron boxes standing on small iron trucks, and conveyed away immediately. When cold it is broken in pieces and converted into neutral sulphate (salt-cake) for the alkali manufacture by ignition with common salt.

The nitric acid as produced is always tinged more or less with yellow, owing to the presence of hyponitric acid, and contains an amount of hydrochloric acid corresponding to the proportion of chlorine in the nitre employed. It is, further, often contaminated with traces of sulphuric acid, sulphate of soda, ferric oxide, and iodine. To prepare chemically pure nitric acid, the tetrahydrated acid at specific gravity 1·42 (43° B.) is distilled in glass retorts, and the liquid which first passes over is kept separate as long as it produces a turbidity with a solution of silver nitrate. The receiver is then changed, and the acid is distilled over down to a small residue.

For many technical purposes it is requisite to have nitric acid free from chlorine, whilst the other impurities, when present in small quantity, have no prejudicial effect. Some establishments, for this purpose, wash the Chili nitre with pure water—or, better still, with a saturated solution of nitre free from chlorine—until all the common salt is removed. Others prefer to remove the chlorine after the acid is prepared, which is easily effected by heating the acid in stoneware pans in a water-bath, and simultaneously forcing a current of air through it by means of an air-pump. The escaping hyponitric acid containing chlorine is conducted into a coke-tower. In this manner the nitric acid is obtained as clear as water, and free from chlorine and hyponitric acid.

R. Wagner proposes† to employ in the preparation of nitric acid the hydrated alumina obtained as a by-product in the treatment of cryolite and bauxite. If this is ignited with Chili nitre, nitric and hyponitric acids escape, the latter being utilised by treatment with air and water. The residual aluminate of soda is decomposed with carbonic acid into carbonate of soda and hydrate of alumina, the

* Schwarzenberg, "Nitric Acid," in Bolley's "Technologie, II., 2, 304. Brunswick: 1865.

† R. Wagner, *Wagner's Jahresber.*, 1865, 249.

latter being utilised in the decomposition of fresh quantities of nitre. Instead of the hydrated alumina, Wagner thinks it possible to use finely-divided silica, as obtained on the decomposition of soluble glass or of fluoride of silicium. This method, proposed as early as 1865 by Wagner, has subsequently been twice patented in England, in 1867 by J. Poole, W. Stase, and H. Baker,* and in 1870 by J. H. Johnson.† As far as known to the author, this method has not been carried out on the large scale.

Tessié du Motay‡ proposes to pass a mixture of ammonia and oxygen over manganates, permanganates, and chromates heated to 340° to 560°, decomposing the nitrates thus formed by air and steam at a red heat, when nitric acid is liberated, and the chromates or manganates are regenerated. Like so many other suggestions of this much-inventing chemist, the process has not come into industrial utilisation.

R. Weber§ has recently made known a method for obtaining Ste.-Claire Deville's anhydrous nitric acid easily and in quantity. He adds anhydrous phosphoric acid to the refrigerated monohydrated nitric acid, and distils at a gentle heat. The distillate consists of two non-miscible liquids. The upper stratum is decanted off and cooled below 0°, when crystals of nitric anhydride are formed in abundance. According to Weber's statement, confirmed by Berthelot,‖ the yield is very satisfactory.

A very sensitive test for nitric acid is sulphate of brucin, which gives an intense red colour. On adding stannous chloride a violet precipitate is produced.

According to the statement of C. D. Braun,¶ confirmed by Böttger,** sulphate of aniline is equally sensitive with the brucin salt. A solution of aniline sulphate is prepared by dissolving 10 drops of aniline in 50 c.c. of dilute sulphuric acid (1 : 6). Half a c.c. of this solution is then placed in a watch-glass, mixed with 1 c.c. of concentrated sulphuric acid, and a glass rod moistened with the liquid to be tested is drawn through the margin of the mixture. In presence of nitric acid red stripes appear, and the whole liquid gradually turns of a rose colour. If more nitric acid is present the colour becomes a deep red-brown, and finally a brownish yellow. According to Reichardt,†† 1 part of nitre dissolved in 1000 parts of water gives no reaction with the aniline solution, whilst 1 part of nitre in 100,000 parts of water gives a very distinct colouration with brucin.

For the determination of small quantities of nitric acid in potable waters a great number of methods have been proposed. Recently, F. Tiemann‡‡ has made very accurate comparative experiments on the determination of nitric acid in the analysis of water. He arranges all the methods in four classes.

I. Methods which depend on the transformation of the nitric acid into ammonia in an alkaline solution and in presence of a metal. F. Schulze§§ first based a method upon this principle, and effected the reduction by platinised zinc. Wolf,‖‖ Harcourt,¶¶ and Siewert*** employ zinc and iron filings; Bunsen,††† a spiral of zinc-iron; and Chapman,‡‡‡ aluminium-foil. In all these cases the ammonia generated is isolated by distillation, and if in large quantity determined by means of a standard acid, but if in small traces by means of Nessler's test. According to Frühling's statements,* confirmed by Tiemann, the methods based upon this principle give inaccurate results in presence of organic matter. Finkener† observed that all the nitric acid was decomposed, but that in no case was all the nitrogen completely converted into ammonia.

II. Determination of the nitric acid by reduction to nitric oxide and re-conversion into nitric acid. This method, proposed first by Schlösing,‡ and then modified by Reichardt,§ depends on the reduction of nitric acid to nitric oxide by the action of ferrous chloride and hydrochloric acid, oxidation of the nitric oxide to nitric acid by means of oxygen and water, and titration of the acid with a dilute soda solution. Schlösing receives the nitric oxide gas over mercury, whilst Reichardt applies soda-lye, which according to his experiments absorbs mere evanescent traces of nitric oxide.

III. Methods which determine nitric acid by measurement of the nitric oxide evolved. Walter Crum,‖ as also Frankland and Armstrong,¶ decompose the nitrates in a highly concentrated solution by concentrated sulphuric acid, and reduce the liberated acid to nitric oxide by agitation with mercury. Crum measures the nitric oxide in the decomposition-tube, whilst Frankland and Armstrong make use of a gasometric apparatus. Like Schlösing, F. Schulze** decomposes the nitrates with hydrochloric acid and ferrous chloride, and receives the nitric oxide, liberated on the application of heat over moist mercury, determining the quantity by measurement. This method, which according to Wulfert†† and Tiemann gives very accurate results, has been modified by the latter,‡‡ who employs soda-lye in place of mercury.

(To be continued.)

THE ACTION OF HYDROCHLORIC ACID ON THE METALLIC SULPHATES.

Communicated by Prof. ALBERT B. PRESCOTT.

To find certain constants of the decomposition of the inorganic sulphates by hydrochloric acid, under stated condition, a series of quantitative determinations was instituted. The results already obtained and here given are from the work of Messrs. A. L. Young and G. F. Dixon, done in the laboratory under my instruction.

The *conditions* fixed upon were as follows:—To 1·000 grm. of the sulphate, in a porcelain evaporating dish, were added 3·5 c.c. of hydrochloric acid of sp. gr. 1·153 (1·251 grms. of HCl with 2·784 grms. of water, as 4·035 grms. of aqueous acid). This quantity of hydrochloric acid gives a chemical excess of chlorine, ranging from 2·2 and 2·3 to 5·4 times the quantity required to displace the sulphuric acid radical. (The least excess of chlorine occurs with the ammonium and calcium salts; the greatest excess with the silver salt.) The material was then evaporated on the water-bath to apparent dryness, stirring with a glass-rod at the close of the evaporation, and, to remove free hydrochloric acid, three portions of 4 c.c. of water were added with evaporation to dryness in the same way after each addition, when the last dry residue was left one hour on the water-bath. The entire operation on the water-bath continued about five hours.

The formation of chloride was estimated gravimetrically as silver salt; the residue of final evaporation being

Deutsche Industrie Zeitung, 1867, 153; *Wagner Jahresber.*, 1867, 198.

† J. H. Johnson, Specification 2806, October 31, 1870. (The process was tried experimentally in England about 1850 at the works of Messrs. Metz and Halcrow, Droylsden, near Manchester, but was not considered remunerative.—Ed. C. N.)

‡ *Deutsche Industrie Zeitung*, 1871, 388.

§ R. Weber, *Pogg. Ann.*, cxxxii., 113; *Berl. Chem. Gesell.*, 1872, 804.

‖ Berthelot, *Bull. Soc. Chim.*, 1873; *Ber. Chem. Gesell.*, 1873, 1560.

¶ *Zeit. Anal. Chemie*, 1867, 71; *Wagner's Jahresber.*, 1867, 147.

** *Jahresber. Phys. Vereins Frankfurt*, 1866-67, 12. *Wagner's Jahres.*, 1868, 254.

†† *Arch. Pharm.*, [2], cxlv., 108. *Jahresber. d. Chemie*, 1871, 893.

‡‡ *Ber. Chem. Gesell.*, 1873, 1034.

§§ F. Schulze, *Chem. Centralblatt*, 1861, 657 and 833.

‖‖ Wolf, *Chem. Centralblatt.*, 1862, 561.

¶¶ Harcourt, *Chem. Soc. Journ.*, xv., 385.

*** Siewert, *Ann. Chem. Pharm*, cxxv., 293.

††† Bunsen, *Zeit. f. Analyt. Chemie*, 1870, 414.

‡‡‡ Chapman, "Sutton's Volumetric Analysis," second edition, 80.

* Frühling, *Landw. Versuchsst.*, viii., 473.

† Reichardt, *Arch. Pharm.* [2], cxlvi., 24.

‡ Schlösing, *Ann. Chim. Phys.*, [5], xv., 101. *Journ. Prakt. Chem.*, lxii., 142.

§ Reichardt, *Zeit. Anal. Chemie*, 1876, 24.

‖ Crum, *Ann. Chem. Pharm.*, lxii., 23.

¶ Frankland, *Chem. Soc. Journ.*, [2], v., 1867.

** Schulze, *Zeit. f. Analyt. Chemie*, 1870, 401.

†† Wulfert, *Dissert. Univ. Rostock.*

‡‡ Tiemann, *Ber. Chem. Gesell.*, 1873, 1041.

treated with a large quantity of water, any part not soluble being filtered out and washed, the solution acidulated with nitric acid and precipitated with silver nitrate, the washed precipitate dried in the dark, and weighed as silver chloride, from which was calculated the weight of chloride of the metal under investigation. The operation on silver sulphate was of course shorter, the chloride formed by action of hydrochloric acid being taken for weight. The quantity of *sulphate remaining intact*, as given in the table, was calculated from the quantity of chloride found to be formed. In a few cases the sulphate in the filtrate from the silver chloride was precipitated as barium salt and its weight obtained—not, however, with any confidence that the free sulphuric acid had been fully expelled, and normal sulphates obtained in the repeated evaporations on the water-bath. These direct determinations of residual sulphate are here put in comparison with the calculated quantities of undecomposed sulphate as placed in the table farther on:—

	Residual Sulphate found from Barium Salt.	Undecomposed Sulp' Calculated from Chloride formed.
$Na_2SO_4.10H_2O$ { 0·870 / 0·868 / 0·871 }	0·8696	0·807
$(NH_4)_2SO_4$	0·9010	0·898
$Al_2(SO_4)_3.18H_2O$ ..	0·9020	0·895

The lead sulphate left insoluble on treating with water, after the action of the hydrochloric acid, was found to be 0·992 (from triplicates, 0·995, 0·991, 0·990); the amount calculated from the chloride being also 0·992.

The operations of treatment with hydrochloric acid and determination of metallic chloride produced, as above described, were all made in triplicate, each result in the table being a mean of three parallel determinations.

Production of Chlorides by treating 1·000 *grm. of each Metallic Sulphate with* 4·035 *grms. of Aqueous Hydrochloric Acid containing* 1·251 *grms. of* HCl (3·5 *c.c. of acid of* 1·153 *sp. gr.) and evaporating to dryness on the Water-bath.*

Sulphate taken.	Quantity of Chloride formed.	Quantity of Sulphate not Decomposed.	Proportion of Metal changed to Chloride.
	Grm.	Grm.	Per cent.
Ag_2SO_4	0·920	None	100
$HgSO_4$	0·915	,,	100
$Bi_2(SO_4)_3$	0·027*	0·836*	*
$Na_2SO_4.10H_2O$..	0·070	0·807†	19·3
$Al_2(SO_4)_3.18H_2O$	0·042	0·895†	10·5
$(NH_4)_2SO_4$ ..	0·083	0·898	10·2
$CoSO_4$	0·072	0·914	8·6
$CuSO_4.5H_2O$ ..	0·019	0·964†	3·6
$FeSO_4.7H_2O$ ..	0·013‡	0·977†	2·3
$CdSO_4$	0·017	0·981	1·9
$ZnSO_4.7H_2O$ ..	0·007	0·990†	1·0
$PbSO_4$	0·007	0·992	0·8
$MnSO_4.4H_2O$ ..	0·004	0·992†	0·8
K_2SO_4	0·006	0·993	0·7
$MgSO_4.7H_2O$ ..	0·003	0·995†	0·5
$Sb_2(SO_4)_3$	None	1·000	—
$CaSO_4$	,,	1·000	—
$SrSO_4$..	,,	1·000	—
$BaSO_4$	,,	1·000	—

The considerable production of aluminium chloride seems to contradict the well-known instability of aluminium chloride, and invites more investigation, particularly as to the formation of sulphate and chloride in one compound.

I hope to present at another time the results of treating the sulphates with hydrochloric acid under other conditions of concentration, temperature, and proportion; also the products of chlorides with sulphuric acid.

University of Michigan, Ann Arbor,
August 31, 1877.

* On treating with water, after the evaporation of the hydrochloric acid, a residue was obtained consisting of bismuth, sulphate, and chloride united, and the weight of this residue (0·836) is given in the column of undecomposed sulphate. The "0·027" is only the chloride found in the filtrate.

† Stated in quantity of crystallised salt of the formula of the sulphate taken.

‡ Found to be ferric chloride, and taken as such in calculation of the sulphate left.

DESTRUCTION OF LEATHER BY GAS.

By Prof. A. H. CHURCH.

THE injurious influence of the products of combustion of coal-gas upon the leather bindings of books is only too well known. Vellum seems unaffected; morocco suffers least; calf is much injured, and Russia still more so. The disintegration is most rapid with books on the upper shelves of a library, whither the heated products of combustion ascend, and where they are absorbed and condensed. By comparing specimens of old leather with specimens of new it is quite clear that the destructive influence of gas is due mainly to its sulphur. True there are traces of sulphates in the dye and size of new leather bindings, but the quantity is insignificant, and there is practically no free sulphuric acid. That leather may be destroyed by the oil of vitriol produced by the burning of gas in a library is proved by the following observations and analyses.

The librarian of one of our public libraries forwarded to me the backs of several volumes which had been "shed" by the books on the upper shelves in an apartment lighted by gas. The leather of one of these backs (a volume of the "Archæologia") was carefully scraped off so as to avoid removing any paper or size from beneath. This task of scraping was easy enough, for the leather was reduced to the consistency of Scotch snuff. On analysis of the watery extract of this leather the following figures were obtained:—

Free sulphuric acid in decayed leather	..	6·21	p.c.
Combined	,,	,,	,,	..	2·21	,,
Total	,,	,,	,,	..	8·42	,,

THE PROPOSED CARBOLIC TEST FOR NITRIC ACID.

By DAVID LINDO.

IN testing minute quantities of nitrates in the solid state by this method, transfer the substance to a small porcelain capsule, and dissolve it in two or three drops of the carbolic solution (5 grains to the ounce),* then add cautiously three or four drops of concentrated sulphuric acid.

If the colour is not very full at first, this may arise from the amount of nitrate being too large for the quantity of carbolic solution employed, in which case the addition of a little more of the latter will greatly improve the reaction.

In testing *solutions* supposed to contain traces of nitrates, a very good method is to mix 30 minims of the suspected fluid with the same bulk of pure and highly concentrated sulphuric acid in a small porcelain basin.

Give the vessel a slight rotatory motion to ensure complete mixture, and *at once* pour a small quantity of the carbolic solution gently down the side of the dish, so

* The easiest way of preparing the carbolic solution is to place the bottle containing the crystallised acid in warm water, and when the crystals are fused, use 5 minims of the fluid to each ounce of distilled water. This will be a little more than 5 grains, which is of no consequence. The water of course must be heated to take up the acid.

that it may spread over the surface of the hot mixture. If the dish is left undisturbed, the colour soon appears if nitric acid is present.

By proceeding in this way, I have easily detected the nitric acid in 30 minims of a solution of one grain of nitre in 20 ounces of distilled water, and I have obtained faint reaction with a solution of half this strength.

But if the temperature of the mixture is allowed to fall before adding the carbolic solution, the experiment will fail with these minute traces of nitrates, and by applying heat afterwards, you will rarely succeed in developing the colour in a satisfactory manner.

When applying the test the other way—that is by mixing the carbolic solution with sulphuric acid, and adding two or three drops of the nitrate solution—it is perhaps preferable to mix the carbolic solution with an equal volume of concentrated sulphuric acid, instead of with three times the quantity as formerly prescribed.

If strong hydrochloric acid is mixed with some carbolic solution, and a little nitric acid added, no colour is observed at first, or only yellow, but on applying heat the magenta colour appears. Boiling the mixture destroys the colour. The same results are obtained with nitrates, but sulphuric acid is much to be preferred to hydrochloric in making use of the reaction as a test for nitric acid.

Chlorates, iodates, chromate of potash, ferricyanide of potassium, and other oxidising agents, if added to the mixture of carbolic and sulphuric acids, produce olive, yellowish green, and dirty brown colours, which, in no way resemble, and therefore cannot be mistaken for, the colours obtained with nitric acid. The presence of any of these substances however, would of course interfere more or less with the action of the test.

I may here state that I have been unable to trace the changes that take place when these three acids are brought together in the manner described.

The action of nitric acid alone on carbolic acid is well understood, but it appears that some reaction not hitherto recorded takes place between these two substances in the presence of another and more powerful acid. Possibly some organic base is formed which unites with the stronger acid, in which case the highly coloured fluid obtained would be a solution of the salt thus produced in the excess of strong acid. I should like, however, to see the matter fully explained, as this would greatly assist in determining the true value of the reaction as a test for nitric acid.

Falmouth, Jamaica, September 18, 1877.

PROCEEDINGS OF SOCIETIES.

RUSSIAN CHEMICAL SOCIETY.

June, 1877.

F. Wreden, "*Hydrogenisation of Benzene and its Homologues.*" Berthelot's reaction with HI has been carefully studied, and the results would show the inability of benzene and its homologues to assume more than six additional atoms of H, as well as establish the existence of a series C_nH_{2n}, the members of which, like those in the methane series, cannot enter into direct combination, and are marked by a stability against reagents and a tendency toward complicated reactions. Toluen yielded hexa-hydrotoluen, C_7H_{14}, a colourless mobile liquid, boiling at 94° to 100°. Hexa-hydro-isoxylol, C_8H_{16}, was obtained in a similar manner.

A. Lenz, "*By-products in the Manufacture of Illuminating Gas from Wood and Petroleum.*" The residues are found to contain the same constituents as those derived from coal, viz., aromatic hydrocarbons and phenols, naphthalin, anthracen, and phenanthren; all of which are likewise obtained by conducting petroleum through red hot tubes filled with charcoal.

W. Markownikoff, "*Derivatives of Normal Pyruvic Acid.*" The anhydride has been obtained by the action of acetyl chloride on the silver salt. It crystallises in white fine needles, melts at 56°, and resembles succinic anhydride in many properties. It forms with acetic anhydride a compound crystallising in needles an inch long. When left in contact with alcohol it forms the acid ethylic pyruvate, a thick acid liquid. The anhydride is prepared in an impure form by heating the acid alone.

K. Lissenko, "*Calorific Power of Naphtha.*" Some forms of petroleum which yield a less amount of heat on combustion than calculated are regarded as containing hydrocarbons of the series C_nH_{2n+2}, accompanied by small quantities of non-saturated hydrocarbons.

A. Orlowsky, "*Synthetic Preparation of Ethenyl-tricarbonic Acid.*"

G. Gustavson, "*Penta-bromo-toluen, and Decomposition of Cymene by Bromine in the Presence of Aluminium Bromide.*" By the addition of bromine containing a small quantity of Al_2Br_6 to toluen at 0°, penta-bromo-toluen is obtained, $C_6Br_5CH_3$, easily crystallised from benzene, melting at 282°, and subliming in crystals like those of C_6Br_6. The same reaction with cymene yields, likewise, penta-bromo-toluen, and isopropyl bromide.

NOTICES OF BOOKS.

A System of Volumetric Analysis. By Dr. Emil Fleischer. Translated, with Notes and Additions, from the Second German Edition. By M. M. Pattison Muir, F.R.S.E. London: Macmillan and Co.

The first question which will be asked by the student in taking up this work is—What distinctive features does it present? In reply, the author and the translator tell us that their object has been, not to give an encyclopædia of recipes for volumetry, but to lay before the student such methods only as are trustworthy and simple, doing away with or modifying all uncertain final reactions. Dr. Fleischer, we learn, attempts to divide volumetric processes into a few great groups, pointing out definitely the principles on which each group is based, and illustrating the application of such principles by well-chosen practical examples. The methods proposed for volumetric separations will deserve the careful attention of analytical chemists. To develop such methods has been the author's chief object, and he calls on his readers to pursue the path which he has thus opened up. Volumetric processes are in this work divided into the following sections:—Analysis by saturation, including alkalimetry and acidimetry: analysis by oxidation and reduction, including oxidimetry and iodometry; and, lastly, analysis by precipitation. As concerns the last class, the author has abandoned all volumetric precipitation analyses except those the termination of which can be determined by a sudden change in colour, or those which may be used conjointly with an oxidation or saturation method. For the standard solutions used in alkalimetry and acidimetry hydrochloric acid and ammonia are recommended, the former being employed as normal and the latter as semi-normal. His experiments have proved that the value of a normal hydrochloric acid is unaltered after being kept for half a year, and that no acid reaction is obtained with litmus-paper placed in the steam given off by decinormal or even one-fifth normal acid kept at a boil for ten minutes. The semi-normal ammonia solution is practically unaltered in value after being preserved in stoppered bottles for four months, and in three months no carbonic acid is absorbed. As an indicator, after carefully examining a number of recently proposed substitutes he gives the preference to litmus, or to tincture of cochineal. The latter, being much less affected by carbonic acid than is litmus, is therefore preferable in the titration of alkaline

carbonates. In the presence of salts of iron or aluminium —or, as we might more generally say, of metals capable of acting as mordants or alterants—cochineal does not give trustworthy indications. "Tincture of georgia" is a substance which will probably puzzle the reader, or any dealer in reagents to whom he may apply. We beg therefore to state that "georgia," or "georgina," is the German name for the flower known among us as the dahlia, a tincture of the dark purple varieties of which has been proposed as an indicator. Dr. Fleischer gives the important caution that in working with the standard ammonia solution the liquids should be perfectly cold, since ammoniacal salts, especially the sulphate, have the power of feebly reddening litmus in warm solutions. In the estimation of copper Dr. Fleischer reduces to suboxide with tartaric acid, caustic alkali, and glucose, dissolves in a solution of pure ferric sulphate, and deduces the quantity of copper present from the amount of ferrous salt produced.

The separation and determination of cobalt and nickel is thus effected. The acid solution of the two metals is decomposed by caustic soda and chloride of soda in excess; the black precipitate is filtered off, boiled with dilute ammonia, and again filtered. The residue, containing all the cobalt and a part of the nickel as NiO, is treated with a known volume of ferrous sulphate, and subsequently titrated with permangate. The cobalt being thus determined, the mixed sesquioxides are next precipitated in a fresh portion of the original liquid, and the precipitate is treated with ferrous sulphate *without* a previous boiling in ammonia. On titrating with permanganate the joint quantity of the two metals is found, from which the weight of nickel is of course readily calculated.

The second part of the book is devoted to methods of separation as preliminary to volumetric determinations. The first section treats of the separation of the bases from each other; the second, of the estimation of the bases without separation of groups or of individual bases; and the third of the separation and estimation of the more important acids. It seems to us that there is in this region room for much useful work, and that volumetric analysis has before it a future greater than has been generally supposed. The author's method is to separate each base in turn from a solution which may contain all the bases, reverting to the original solution, which is to be divided into as many portions as there are bases, or groups of bases, to be determined. He remarks that "The process of analysis is thus much shortened, not only by the omission of group separations, but also by the fact that but one, or at the most two, filtrations are necessary; in many instances no filtrations are required. The precipitates do not require the same long-continued washing which consumes so much time in the ordinary processes. Two circumstances more especially recommend the methods under consideration. Every estimation is readily controlled by repeating the process on the original liquid; the analyses of technical products in which one or more, but not all, the constituents is to be determined, becomes a matter of ease, and can be carried out much more rapidly than when it is necessary to make a systematic separation of the metallic groups." The author's process is worked out for twenty metals in a table, which we cannot conveniently here insert, but for which we would bespeak careful study and experimental trial.

The third part of the book gives instructions for the quantitative analysis of certain substances of especial technical importance.

In the appendix Mr. Pattison Muir adds the figure and description of a simple and ingenious arrangement for rapid filtration, which no doubt many of our readers will find useful.

In speaking of potable waters the author, or the translator—for we are not quite sure to whom the responsibility for the closing paragraph belongs—remarks that—"The ammonia process appears to be exceedingly useful in measuring comparatively the quantities of decomposing organic matter in water. When we attempt to measure organic matter which has not begun to decompose, or organic matter (such as peaty matter) which only decomposes with difficulty, the process cannot be relied upon. Of course it is decomposing organic matter which is especially harmful."

One unfortunate point in the work before us is that the author and translator do not agree. Dr. Fleischer, like Fresenius, is an upholder of the notation employed, *e.g.*, in Gmelin's "Handbook of Chemistry," whilst Mr. Pattison Muir is an uncompromising adherent of the notation and nomenclature employed in the so-called "new chemistry." We do not see that a treatise on chemical analysis—gravimetric or volumetric—is the place for discussing this "very pretty quarrel." In the case before us the difficulty has been compromised by inserting the formulæ according to *both* systems, which must have somewhat added to the cost of producing the book. In spite, however, of this misfortune, the work must be pronounced a valuable addition to English chemical literature. It abounds in practical hints and precautions calculated to guard the student against possible inaccuracies; it is plain, intelligible, and compendious, and unburdened with the introduction of alien matter. All chemists who have occasion to make use of volumetric processes will find Dr. Fleischer's work a useful laboratory companion.

The Lazy Lays and Prose Imaginings. Written, printed, published, and reviewed by W. H. HARRISON. A.D. 1877 (Popular Chronology). A.M. 5877 (Torquemada). A.M. 50,800,077 (Huxley). London: 38, Great Russell Street.

WHEN a work is sent to us for review we naturally infer that it in some way or other professes to deal with scientific questions. In the present case the inference is corroborated by the fact that some portion, both of the poetry and the prose herein contained, touches on chemical and physical subjects. Thus we find a "Lay of the Photographer," and a poem on the Appointment of a Public Analyst at Folkestone, and essays on "Materialistic Religion" and on "Wirbel-bewegung," the two latter of which are certainly well worth reading, and commend themselves to the sympathies of all such men of science as do not fancy themselves wiser than what is demonstrated. But there is much in the book painfully puzzling. Why do we find, on the very title-page, the name of Torquemada selected as an authority for the shorter date of the earth's existence, and that of Huxley for the longer? Does any deep meaning lurk in the "Song of the Pawnbroker," the "Lay of the Fat Man," or the "Lay of the Broad-brimmed Hat"? What—save on the question of Materialism, where he speaks plainly—is the author's point of view? What does he seek to prove, and what to disprove? Wanting light on this question, how can we decide whether or no he has made out his case? Even in the "Public Analyst" it is impossible to ascertain whether Mr. Harrison is or is not ridiculing public analysts in general or the gentleman who holds the Folkestone appointment in particular. The "Lay of the Photographer," too, has its mysteries, in spite of the marginal comments. Why is Prof. Clifford classed among the "poor relations" of Pyroxylin? And why are "Odling and Caithness" selected to bear in the dead? The "Lay of the Mace-bearers" promises some jokes at the cost of—

> ——— "a great British Ass...
> ...ociation for plastering Science over...
> On the back of the ... at later, west Poss...
> This superior Mayor with his Mace-bearers three."

But the promise is not fulfilled.

In a poem entitled "The Castle" Mr. Harrison tells us that—

> "O'er the race of humanity Freedom is dawning,
> And a happier time for mankind is at hand."

The man who can at present entertain such a belief must

even surpass Mark Tapley in the faculty of being jolly under creditable circumstances!

Elements of Chemistry, Theoretical and Practical. By W. Allen Miller, M.D., &c., late Professor of Chemistry, King's College, London. Revised by H. McLeod, F.C.S. Part I. Chemical Physics. Sixth Edition. London: Longmans and Co.

Dr. Miller's work is so generally—and we may add so favourably—known to the majority of chemists in this country that any explanation of its character and peculiarities would be quite superfluous. The present edition has been brought up to the present state of knowledge by the addition of notices of the most recent discoveries in each branch of chemical physics. The section on polarised light—an agent of great value to the chemist in the study of certain organic compounds—has been considerably enlarged and modified. The account of the researches of Dr. Andrews on thermo-chemistry—the heat evolved on the combination of bodies—and on the condensation of gases, have been carefully revised by their author. Those numerous chemists who refuse to recognise the principle that "a rose by any name will smell as sweet" will be glad to learn that "an attempt has been made to bring the terminology of the work into accord with the views of the present time." What is of much greater importance, all references have been re-verified, all numerical statements—as far as possible—re-calculated, and a number of incidental inaccuracies thus detected and removed.

After a careful examination of this volume we may fairly congratulate the editor on the complete, and at the same time compact, manner in which the results of the latest research have been here embodied. We have always found it a good rule first to refer to Miller, if in search of some piece of chemical or physico-chemical information not everywhere to be met with, and we feel little doubt that in its present enlarged and improved form it will merit this character still more decidedly than before.

A Course of Scientific German. By H. B. Hodges. Boston: Ginn and Heath.

Now Latin has ceased to be the language in which discoveries and researches are revealed to the world—with the sole exception of entomology, where it still exists as an anti-Darwinian case of the survival of the unfittest—every man of science finds it increasingly necessary to be acquainted with the three leading languages of the world, English, French, and German. Mr. Hodges has observed that many students who have paid considerable attention to the German language still find great difficulty in reading the German scientific journals. This difficulty he ascribes to the fact that at schools and colleges the student of a foreign language is made acquainted with its polite literature, and with the words and phrases of daily life, to the exclusion of the language of the laboratory and the workshop. Such complaints are especially applicable to the German language, since its technical terms, as used in the sciences and the arts, differ greatly from the corresponding English or French expressions. To remedy this evil Mr. Hodges has prepared a course of German intended to familiarise the student with the special terms, the phraseology, and the style he will meet with in German scientific works and journals. The reader, who is supposed to have a general knowledge of the language, will find first a series of exercises in German and English, selected from standard text-books on physics, chemistry, mineralogy, and botany, each exercise being preceded by a vocabulary of technicalities, and followed by questions to be answered in either language, as the case may be. Next follow scientific essays taken from the writings of Liebig, Helmholtz, &c., whilst a glossary—German-English and English-German—concludes the work. In this glossary we have, after a very careful examination, found merely two slight errors. "Mikroscop," not Mikroscope, is a neuter, not a feminine noun, and in the English-German department "tumeric" is incorrectly put for "turmeric." We should have considered this a mere typographical error had not the word been placed in accordance with the unusual orthography here adopted. Many words seem to us, however, superfluous, such as soda, borax, blende, calcium, gas, gold, &c.: these might safely have been omitted, and many others—though having no similarity to English technical terms—are by no means peculiar to scientific literature, and can scarcely fail to be familiar to every student of the German language.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. No. 14, October 1, 1877.

Boric Acid: Methods for its Detection; its Origin and Mode of Formation.—M. L. Dieulafait.—Spectrum analysis, under the conditions laid down by the author, permits us to detect with certainty the presence of $\frac{1}{10000000}$ of a grm. of boron. The method with the hydrogen flame as described by the author shows distinctly the existence of $\frac{1}{1000000}$ of a grm. of boron. Boric acid is a normal constituent of the waters of existing seas. Contrary to what might have been expected boric acid concentrates itself in the last mother-liquors of the salt-marshes, above the carnallite in the deliquescent salts, in the state of borate of magnesia. But it is exactly in that place and under these conditions that boric acid is met with at Stassfurt. The borate of magnesia of this celebrated deposit therefore is not, as commonly admitted hitherto, of volcanic origin, but is purely sedimentary. The presence of boric acid can be shown in a single drop of natural sea-water.

Discovery of Oxygen in the Sun, and New Theory of the Solar Spectrum.—M. H. Draper.—Already noticed.

Magnetisation of Tubes of Steel.—M. J. M. Gaugain.—Not adapted for abstraction.

Exact Measure of the Heat of Solution of Sulphuric Acid in Water.—M. Crouillebois.—The heat varies from 4554 calories at 10° to 2420 at 24°.

Continuation of Researches on the Effects Produced by Electric Currents of High Tension and on their Analogies with Natural Phenomena.—M. G. Planté.—This paper would be imperfect without the accompanying illustrations.

Some New Researches on the Metal Davyum.—Sergius Kern.—See Chemical News, vol. xxxvi., page 114.

New Methods of Formation of Oxide of Ethylen. M. H. Greene.—Silver oxide reacts very readily upon ethylen iodide at 150° and yields ethylen oxide. With bromide of ethylen and oxide of silver ethylen oxide is produced in like manner, but the reaction requires a much higher temperature (250°). Bromide of ethylen reacts very distinctly with oxide of sodium at 180°, and yields oxide of ethylen.

Note on Drawing Platinum Wire.—M. A. Gaiffe.—The author finds that if atmospheric dust is carefully excluded during the operation of drawing platinum wires, the wire is more tenacious.

Bulletin de la Societe Chimique de Paris,
Nos. 6 and 7, October 5, 1877.

Certain Properties of the Sulphides of Platinum considered from an Analytical Point of View.—M. J. Ribau.—Already noticed.

Studies on Glycerine, Cellulose, and Gum: Transformation of Glycerine into Glucose.—M. C. Kosmann.—Reserved for insertion in full.

Influence of the Alkalinity of various Substances upon the Rotatory Power of Sugar.—M. H. Pellet.—The author finds that there is no relation between the action of alkalies upon sugar and their equivalent, and agrees with Sostmann that their influence upon the rotatory power of sugar is greater in concentrated than in dilute solutions.

The greater part of these issues consists of papers from the *Berichte der Deutsch. Chem. Gesells.*, from *Liebig's Annalen*, and from the *Comptes Rendus*, which have been already noticed under their respective heads.

Constant Presence of a Sulphocyanic Compound in the Urine of the Carnivora.—M. R. Gscheidlen.—The amount of sulphocyanogen excreted daily in the urine of a man is from 0·004 to 0·032 m.grm.—(*Pflüger's Archiv.*)

Presence of Alcohol in the Organism.—M. A. Rajeweski.—The author having injected some rabbits with alcohol and distilled their bruised organs with water, obtained the reaction of iodoform in all cases. But he also obtained the same reaction from rabbits which had not received any alcohol and which had been operated upon as a check experiment. Hence the detection of alcohol by this method is not trustworthy in the case of these animals.—(*Archiv. der Physiologie*).

Presence of Methylamin in the Organism.—M. H. Schwartz.—On distilling fœcal matter with lime the author obtained ammonia mixed with a small quantity of methylamin.—(*Chemisches Centralblatt*).

On Urobilin.—M. J. Esoff.—The author describes a process for the isolation of urobilin. Of 39 specimens of urine 4 displayed directly the absorption-band of urobilin, and 35 only after the addition of a mineral acid. Oxidising and reducing agents destroy urobilin, but it is not affected by fermentation.—(*Archiv. der Physiologie*).

Formation of Glycogen in the Liver.—M. von Mering.—Glucose, sucrose, lactose, inverted sugar, inulin, lichenin, glycerin, arbutin, gelatin, and the albuminoids promote the formation of the glycogen. Inosit, quercit, and the fats do not produce it.—(*Pflüger's Archiv.*)

Examination of Commercial Salicylic Acid.—M. H. Kolbe.—The author dissolves ½ grm. in 5 c.c. of alcohol, pours the solution which ought to be clear into a watch-glass, and allows it to evaporate in the air. The salicylic acid then remains in the form of a ring of crystalline efflorescence. This ring is white if the salicylic acid is of good quality and has been purified by crystallisation; if the acid has been merely precipitated the ring is yellowish or yellow; but if it is brownish or brown, then, even though the powder may be white, the salicylic acid is impure and unfit for medicinal use.

Journal fur Praktische Chemie.
Nos. 6 and 7, 1877.

Hippuric Acid and its Derivatives.—W. Conrad.—The author has made a very extensive study of this acid, subjecting it to the action of a variety of reagents, and examining their derivatives. The results coincide with the hypothesis that hippuric acid is benzoyl-amido-acetic acid, $CH_2(C_6H_5CONH).COOH$. The acid is easily purified by the action of cold dilute HNO_3, and the true melting-point is found to be 187·5°, and not 140° as hitherto given. Nitro-hippuric acid—identical with that found in human urine after partaking of nitro-benzoic acid—was obtained by the action of red fuming nitric acid under pressure, and found to be very stable. Digestion with HNO_3 changes it into glycocol and meta-nitro-benzoic acid. The amide derived from it is likewise decomposed into metamido-benzoic acid, and also changed into oxy-hippuric acid, which yields meta-oxy-benzoic acid and glycocol.

Chloroplatinates.—L. F. Nilson.—This name is assigned to the compounds of the metals with the so-called chloroplatinous acid, or $2HCl.PtCl_2$. This is prepared by heating the tetrachloride to 300°, solution in HCl, purification in the form of the Ba salt, and separation from the solution of the latter by means of H_2SO_4. The solution of chloroplatinous acid cannot be concentrated without changing the acid from $(H.Cl..Cl)_2Pt+xH_2O$ into—

$$\left.\begin{matrix}H.Cl..Cl\\Cl\end{matrix}\right\}Pt+2H_2O,$$

a dark brown amorphous powder, easily soluble, and losing at 100° a second molecule of HCl. The author has obtained from the solutions of the acid salts with most of the metals, and describes minutely their preparation and properties. They are mostly very soluble and deliquescent. They form handsome large crystals of a dark red colour, and with few exceptions contain water of crystallisation, often in large quantities. The glucinum salt would tend to show that that metal is divalent. The valence of the hexavalent metals is, however, not so sharply marked as in other groups of salts.

Preparation of some Platinum Compounds.—J Thomsen.—The author has simplified or altered the methods of obtaining the following compounds pure and in large quantities:—Potassium chloroplatinite is prepared by reducing K_2PtCl_6 with cuprous chloride. The solution of $PtCl_2$ in hydrochloric acid is obtained by adding a concentrated solution of $PtCl_4$ in HCl to a hot saturated solution of potassium chloroplatinite, the resulting K_2PtCl_6 being completely precipitated. The various double salts, the chloroplatinites, are obtained from this solution by the addition of solutions of chlorides. Platinous hydrate is formed by boiling potassium chloroplatinite with exactly enough caustic soda to finish the decomposition, *i.e.*, 2 molecules NaOH. Potassium bromoplatinite results from boiling K_2PtCl_4 and BrNa with a small amount of water. Sodium bromoplatinate is obtained from $PtCl_4$ by boiling with 6 molecules HBr, adding 2 molecules BrNa and evaporation.

Polybasic Acids derived from Phenol and Carbonic Acid.—H. Ost.—By leading CO_2 over heated sodium phenylate, the author has previously obtained, besides salicylic acid and paroxybenzoic acid, a phenol-dicarbonic acid, and a phenol-tricarbonic acid. The former he now prepares in quantities by the action of CO_2 at 250° on a mixture of sodium and potassium phenylate; and finds by experiment to contain the carboxyl groups of both salicylic acid and paroxybenzoic acid. It is, therefore, ortho-para-phenol-dicarbonic acid. The tribasic acid is ascertained to be oxytrimesitic acid by eliminating the hydroxyl. It appears impossible, therefore, to replace more than 3 atoms of H in phenol by carboxyl groups, those in the meta position being entirely unaffected.

Composition of Leadhillite.—H. Laspeyres.—The analyses of this mineral hitherto accepted are shown to be wrong, leadhillite being identical, crystallographically and chemically, with maxite, $Pb_{18}S_5C_9O_{51}.5H_2O$.

Some New Phosphates of Manganese.—H. Laspeyres.—By dissolving Mn compounds met as black oxide or manganates, or permanganates, in syrupy phosphoric acid, and concentrating the solution, four different phosphates are obtained at different stages, all possessing different crystalline properties.

Pyrogallic Acid.—O. Loew.—In order to study more thoroughly the oxidation of pyrogallic acid it was enclosed with a small quantity of sodium phosphate and an atmosphere of oxygen in a churn-like apparatus, and submitted to violent agitation. After half an hour considerable CO_2

had been formed, and the oxidation-products were found to consist of pyrogallo-quinone, $C_{18}H_{12}O_8$, and small quantities of two crystalline acids. Concentrate l aqueous solutions of pyrogallic acid have a remarkable affinity for other gases, absorbing quantities of NO and cyanogen. The latter produces a white precipitate.

New Method of Analysing Milk: Presence of a Hydrocarbon in Cow's Milk which differs from Milk-Sugar.—H. Ritthausen.—The new method is based on the fact that the albuminous bodies in milk are precipitated by cupric oxide not only completely, but without suffering decomposition, and possesses the advantage that all the constituents of milk, with the exception of the water and salts, can be determined in one and the same portion. 10 c.c. are usually used for an analysis, and diluted with 20 volumes of water. 5 c.c. of a solution containing 63·5 grms. of pure crystallised sulphate of copper to the litre are then added, and the solution exactly neutralised with potash. The precipitate settles quickly, the liquid above being perfectly clear. It is then filtered through a weighed filter. The filtrate contains the sugar, which is determined by Fehling's method. The copper precipitate contains not only all the albuminous matter, but also the entire fatty matter, which is extracted by ether, and determined in the usual way. The residue containing the casein is dried over sulphuric acid, then at 105°, weighed, and burnt. The loss of weight is casein. The presence of phosphoric acid, and of the sulphuric acid formed from the casein, prevents the determination of the casein by simply comparing the dried precipitate and the known weight of CuO. The water and total dried substance are obtained by placing 2 to 3 c.c. of the milk in a weighed crucible containing pure quartz sand, and heating at 105°. The difference between the total dried substance and the sum of the numbers for casein, fat, and sugar gives the amount of salts contained. In the fat separated from the casein in this way, very small quantities of a body resembling milk-sugar were found. Several reactions, especially the inability to reduce oxide of bismuth, show, however, its non-identity.

E. Drechsel describes two new pieces of apparatus for the extraction of soluble matter from solids and the separation of liquids.

Decomposition of Gelatin and Albumen by Pancreas in the Absence of Air.—J. Jeameret.—A long series of physiological experiments are detailed, the results of which lead to the following conclusions:—The decomposition of hydrocarbons and of substances containing N by the bacteria in pancreas takes place, not only in the presence of air, but also in its absence, the products being in both cases alike, the latter process, however, requiring much more time. The complete development of the so-called "Kopfchen" bacteria is entirely independent of the presence of air, but requires the presence of bodies containing N. They do not make their appearance in a pure saccharine solution.

On Leucine.—M. Nencki.—The author describes more fully a leucine obtained by him in the decomposition of albuminoid gelatin with pancreas, which differs from the ordinary form in being extremely soluble, and possessing a sweet taste.

Biedermann's Central-Blatt für Agrikultur Chemie, Heft 9, September, 1877.

Meteorology of Forests.—A. Johnen and Dr. J. Breitenlohner.—According to these observations both rain-fall and evaporation are less in dense forests with much underwood than where the thicket has been cleared away.

Examination of the Spring Waters of the Duchy of Meiningen.—A. v. Lösecke and A. Link.—This paper contains tabulated results of a number of specimens of water. The organic impurities appear to have been merely determined with potassium permanganate.

Proportion of Potash and Phosphoric Acid in Various Rocks, &c.—Prof. F. H. Storer.—Already noticed under the *Proceedings of the Bussey Institution*.

Analysis of Certain Soils.—Prof. Fr. Farsky.—Among the author's general conclusions it is laid down that the absorptive power for ammonia and phosphoric acid seems to increase with the percentage of ferric oxide and of alumina present.

Examination of Milk and Butter.—Chr. Jenssen and L. Block.—The authors have investigated an apparatus devised by Lefeldt for the approximate examination of milk. It is a centrifugal machine which is set in rapid motion for about twenty minutes, and then allowed to come gradually to rest. It is then seen how many degrees of the tube which was originally filled with the sample of milk are occupied by the cream. The results, as compared with those given by the "cremometer" on twenty-four hours' standing appear quite "wild." A sample which, in the cremometer showed 15 per cent of cream, gave scarcely anything in Lefeldt's centrifugal, whilst in others, which showed only 10 to 11 per cent with the cremometer, the centrifugal indicated 6 to 7.

Determinations of Fat in Milk by Means of Marchand's Lacto-butyrometer.—F. Schmidt.—An attemp to modify the use of this instrument so as to obtain comparable results.

Les Mondes, Revue Hebdomadaire des Sciences, Sept. 20, 1877.

In a notice on the destruction of the Colorado beetle, the Paris green is described not as an arsenite of copper but merely as cupric oxide, and is directed to be mixed with ten parts of lime and sifted upon the plants before the dew has evaporated.

Sept. 27, 1877.

This issue contains no original chemical matter.

No. 5, October 4, 1877.

Study on the Formation of Crystals.—Karl von Hauer.—This paper treats of the spontaneous decomposition of crystals by the loss of their crystalline water under various circumstances, of which a number of examples are given; of the behaviour of crystals under the influence of light, with especial mention of the formiate of cadmium, the cupro-formiate of strontia, the aceto-nitrate of strontia, the potassio-oxalate, and ammonio-oxalate of chrome. The author's remarks on the first appearance of crystals amount to little more than an announcement of the fact that more regular crystals are obtained by abandoning solutions to spontaneous evaporation than by allowing a hot solution to cool.

MISCELLANEOUS.

Russian Scientific News.—M. Lentz has published some researches on the electric resistance of solutions of different haloid salts. Solutions containing in equal volumes an equal number of molecules of the salt, and if not too concentrated, yield the following electric resistance:—

KCl ..	32·20	NaCl ..	40·01	AmCl ..	32·29
KT ..	31·89	NaT ..	42·50	AmT ..	31·94
KBr ..	30·99	NaBr ..	41·27	AmBr ..	30·90
KCy ..	31·74		—		—
	31·62		41·26		31·71

$ZnCl_2$	49·95	BaT_2	39·45
ZnT_2	50·01	$BaBr_2$ ..	38·57
$ZnBr_2$ ..	50·18		—
	50·05		39·01

This table shows that all the haloids of the same element have nearly the same resistance if the same solutions are weak and contain an equal quantity of molecules. Prof. Lentz's opinion is that the resistance of a solution occurs only at the positive ion or cathion, and not at the negative.

M. Voronzoff has obtained dipropyloxalic acid $[C(C_3H_7)_2HO.CO_2H]$, and is studying its derivatives.

M. Slouginoff has made several experiments on the polarisation of the mercury electrodes during the action of a galvanic current on an aqueous solution of $Hg_2(NO_3)_2$. From one to five elements of Poggendorff were used. In this case the polarisation is not constant, and increases with the time to its maximum—

Polarisation of the anode	reaches	0·030 Daniell.
Ditto cathode	,,	0·028 ,,
Ditto anode and cathode	,,	0·058 ,,

The stronger the current the less time is taken to obtain a maximum polarisation. The concentration of the solution has no influence on the polarisation.

Anthracite has lately been found in the Olonetz Government some 200 miles from Petersburg. A person who knows the explorers has informed the writer that the coal may be used for all metallurgical purposes. The coal was tried on board a steamer and gave fair results.

The coal is to be explored and if the mine is workable the price of the mineral fuel in Petersburg may be very cheap. However, we must wait for further information, as Prof. Inostranzeff examined the coal and found it contained 25 to 30 per cent of carbon and about 30 per cent of ash. A small per cent of sulphur was also present. Perhaps the coal examined by the above-mentioned geologist was from the upper layers, and this may be the reason of the inferiority of the mineral. Several mining engineers have been sent to the place.

The war always gives rise to inventions. Mr. Segal has prepared tea preserved with sugar. It is put up in tin boxes of different sizes; a spoonful of the mixture gives, with hot or cold water, a cup of tea. It must be mentioned that such tea can be used only in regions where this "boisson" is unknown, as its taste only faintly reminds one of tea prepared in the ordinary way.

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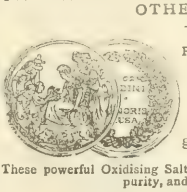

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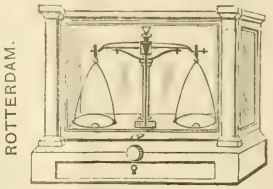

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THE CHEMICAL NEWS.

VOL. XXXVI. No. 935.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 178.)

Nitric Acid and its Salts. By Dr. ADOLPH GEYGER, of Berlin.

IV. Methods which infer the quantity of nitric acid present from its oxidising action upon a solution of indigo. Marx† mixes 50 c.c. of the water to be tested with double its volume of pure sulphuric acid, and adds a dilute solution of indigo to the hot liquid until the colour appears green. The effective value of the indigo solution is determined by means of a solution of saltpetre of known strength, the conditions being otherwise exactly alike. Tromsdorff‡ takes only 25 c.c. of water and 50 c.c. of sulphuric acid; determines approximately the quantity of indigo required by a preliminary experiment, adds this quantity at once, and titrates up to the production of a green colour. Goppelsröder,§ Van Bemmelen,‖ Finkener,¶ and Fischer,** have proposed various modifications of the method. According to Tiemann's experiments the proportions indicated by Tromsdorf are best adapted for practical excution. The determination of nitric acid by means of indigo always yields, however, inaccurate results if the water under examination contains large proportions of organic matter readily oxidisable. The prejudicial effect of such constituents may be partially, though not completely, removed by previously treating the water with permanganate.

Nitric acid is employed in many branches of industry. The manufacture of coal-tar colours requires nitric acid for the preparation of nitro-benzol, binitro-benzol, and nitro-toluol, from which, as is well known, the various aniline dyes of commerce are elaborated; for the separation of phosphin (chrysanilin) from magenta residues; for the oxidation of anthracen to anthraquinon; for nitrising naphthalin and phenylic alcohol. The conversion of arsenious into arsenic acid is in most establishments effected by means of nitric acid. Large quantities of nitric acid are also employed in the manufacture of sulphuric acid, of nitro-glycerin, of gun-cotton, of silver nitrate, and for the preparation of hare- and rabbit-hairs for the use of hatters.

On the Practical Utilisation of Nitrous Oxide Gas. By Dr. OSCAR LIEBREICH, Professor of Medicine in the University of Berlin.

Whilst scientific chemistry in its ceaseless activity produces new substances in rapid succession, and by the charm of this fruitful energy continually acquires creative disciples, we recognise the strange phenomenon that medicine tests in a very deliberate manner these substances, each of which exerts upon the animal economy an influence, even though not invariably capable of useful application. The want of good methods, the exceeding difficulty of deciding upon the benefit produced, especially since it is necessary in the human subject to contend with great idiosyncracies in different individuals, explain this phenomenon. Thus it occurs that bodies which have long been known to the chemist under various points of view, suddenly acquire an increased signification when their utility has been proved in another department. This occurrence is rarer in technology than in medical science. One of the bodies which have acquired a renewed interest by some practical application is nitrous oxide. No longer a mere laboratory product, it is now, like other medicinal agents, prepared on the large scale.

Nitrous oxide is formed in many reactions. It is a product of the treatment of granulated zinc with nitric acid, or by adding the same acid to a hydrochloric solution of stannous oxide. On the large scale, however, the only method used for obtaining the gas is the application of heat to the nitrate of ammonia. As absolute purity is required for medical purposes, the use of a pure salt is important. The kind obtained by neutralising pure carbonate of ammonia with pure nitric acid should be free from chlorine and from sulphuric acid. The well-known reactions with nitrate of silver and chloride of barium show the purity of the materials to be employed. The development of the gas begins at 170°. The chief art in the manufacture consists in the regulation of the heat, which must be moderated when the liberation of the gas commences. If the charge is overheated nitrogen and ammonia are formed, as well as nitric oxide, the most dangerous by-product if inhaled. Even the gas obtained from pure materials, and with the utmost care, requires purification, which is best effected by a passage through a set of washing-bottles, charged with sulphate of iron, potassa-lye, and milk of lime. Any nitric oxide formed is destroyed by the sulphate of iron, acids are retained by the potash and carbonic acid; the least dangerous impurity is further absorbed by the milk of lime.

The organs of dentistry describe minutely the apparatus required, which possesses for chemists no novelty, since it is the same which has been employed in laboratories for the preparation and purification of the gas. In most cases dentists prepare the gas for themselves, but in Berlin an apothecary, Herr Worf, occupies himself with filling gasometers for dentists.

The compression of the gas for sale must be mentioned as a new and interesting feature. This practice was first carried out in London according to Evans's process. The gas used for compression is prepared as above described, and received in iron bottles (about 40 centimetres long by 15 wide) provided with a strong screw-valve. The largest quantities are prepared in London by the mechanician, J. Orchard, jun., of Kensington, and Messrs. James Coxeter and Son, of Grafton Street, through whose hands the cylinders are supplied, have had the kindness to communicate certain figures showing the enormous amount of the consumption. There were sold in—

1871	146,211 gallons.
1872	214,478 ,,
1873	202,252 ,,

The decrease in the year 1873 is explained by a death during narcosis (*British Journal of Dental Science*, Feb., 1873).

The rapid circulation of this calamity through the press discouraged the public. Whilst in January, 1873, 23,000 gallons were sent out; the sale in the month of February, when this misfortune occurred, fell to 10,900, but it has subsequently increased again in an intensified proportion. In Germany the compressed gas has been introduced by the well-known firm, Ash and Son, of Broad Street, London. No special establishments for the manufacture of the Gas in Germany.

After the discovery of nitrous oxide by Priestley in 1776 it was more closely examined in 1809 by Davy,* and its

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Marx, *Zeit. fur Anal. Chem.*, 1868, p. 412.
‡ Tromsdorf, *Ibid.*, 1870, 171.
§ Goppelsroder, *Ibid.*, 1870, 1.
‖ Van Bemmelen, *Ibid.*, 1872, 136.
¶ Rose, *Anal. Chemie*, ii., 831.
** Fischer, *Journ. f. Prak. Chemie*, 1873, 57.

* Chemische und Physiol. Unters. über das oxydirte Stickgas u. das Attimen in demselben, von Humphry Davy. Aus d. Eng., 1812-1814.

essential properties determined; the compression of the gas to a liquid was, however, first effected by Faraday. Davy observed that the gas if respired produced in man a peculiar condition, and this experiment has since been often repeated with confirmatory results. A peculiar excitement appears; the senses disappear at the first inhalations, and a singular drumming is felt in the ears. The body experiences a peculiar sensation of comfort, and the observer recognises the symptoms of merriment. The name of laughing-gas was therefore given to the gas by Davy on account of these properties, although in certain rare cases the excitement may pass over from cheerfulness to the opposite state of sadness. On continued respiration complete unconsciousness occurs, and finally death. This power of the gas to produce unconsciousness, discovered by Davy, was not practically utilised till later. In 1844, two years before the introduction of chloroform by Simpson Horace Wells, a practical dentist applied nitrous oxide to himself, the narcosis being conducted by the chemist Dr. Colton. The new process, however, did not come into extended use prior to 1863. Narcosis for the extraction of teeth was often resorted to by dentists under Colton's superintendence, and in 1867 it came to the knowledge of the celebrated dentist, Evans, of Paris. From this time the scientific utilisation of the method must be dated. On March 31, 1868, the gas was tried by Evans on several patients in the Dental Hospital of London, and by the donation of £100 means were provided for testing the merits and defects of the process. The first report* on its results for dental purposes was very satisfactory, especially as regards a large number of cases conducted by Woodhouse Braine.† The gas now came into increasing use also on the Continent.

Various apparatus were required to facilitate the inhalation of the gas. There are simple mouthpieces through which the gas streams, and there are more complicated ones which permit the simultaneous entrance of air. There are also gasometers of special construction for receiving the needful quantity of gas. A large selection of such contrivances may be seen in the establishment of Messrs. Ash and Son.

As regards the application of the gas, it has been ascertained with certainty that the narcosis thus produced can be used only in such cases as require a short insensibility to pain. For dental operations the gas is therefore peculiarly suited. For more extensive operations in the cavity of the mouth it is less to be recommended. With skilful management it is possible greatly to reduce the stage of excitement or to get at once beyond it. A great advantage as compared with other anæsthetics is that a tendency to vomit scarcely ever appears at the first inhalation. The action of the heart is scarcely affected, and after the readmission of air the insensibility of the patient quickly disappears, and the general condition of the system is entirely normal. Attempts have been made to operate with mixtures of nitrous oxide and other narcotics. Thus C. Sauer (*Vierteljahrs f. Zahnheilkunde*, iv. Heft, 1869) has experimented with nitrous oxide and chloroform. An instructive treatise on the use of nitrous oxide gas alone for dentists has been published by Dr. C. Grohnwald.‡

Although the practical application of this agent has been found useful, we have but few and insufficient facts towards a scientific explanation of its action. It seems that nitrous oxide does not give up its oxygen for combustion, and does not enter into chemical combination with the red blood-globules, since, as Nawrocki has shown, its absorptive relations for blood and for water are almost identical. On respiration dyspnœa and asphyxia are produced just as on the inhalation of other indifferent gases, but the sense of suffocation is masked by the peculiarity of the intoxication. We must content ourselves with seeking the explanation of the action of the gas in the fact that it suppresses the function of the ganglia apparatus of the brain. Direct action upon the nervous organs of the heart has not been traced. Slight as are these scientific data, they yield valuable indications for its application, which correspond with practical experience. In the first place, the gas must not be inhaled for a long time consecutively; secondly, it is advantageous to mix with it at least one-tenth volume of atmospheric air; the longer the narcosis is required the more air must be admitted, though the proportion must not exceed quarter volume. Especial attention must be paid to the respiration of the patient. That even with this method of inhalation unfortunate results occur need not surprise us, since from incidents not hitherto explained the use of almost every anæsthetic has demanded its victims. The statistical numbers published testify for its relative safety.

It cannot, however, be denied that the complication of the arrangements required for inhalation is an inducement to seek for new agents suitable for the purposes of dentistry. Thus the author has successfully applied, both in short and in protracted operations, ethylidenchloride, which, according to Hofmann, is abundantly formed as a by-product of the formation of chloral from alcohol. It has also been found suitable for dental operations by C. Sauer, of Berlin, in a long series of experiments.

(To be continued.)

* First Report by the Joint Committee of the Odontological Society of Great Britain, and the Committee of Management of the Dental Hospital of London, to enquire into the value and advantage of the presence of nitrogen as an anæsthetic in surgical operations. *Trans. Odont. Soc. of Great Britain*, i., No. 2.

† Braine, *loc. cit.*, No. 7.

‡ Grohnwald, "Stickstoffoxydgas als Anæstheticum." Berlin; 1871.

ON THE ANALYSIS AND VALUATION OF SPENT OXIDES OF IRON FROM GAS WORKS.

By GEORGE E. DAVIS.

In the CHEMICAL NEWS, vol. xxix., p. 30, I pointed out that there were sometimes present in spent oxides substances generally disregarded, but which played a very important part in the vitriol manufacture. Lime, or carbonate of lime, when present, abstracts or retains an equivalent of sulphur in burning the spent oxide, so that the amount now usually given on the assay note as available sulphur is not always available, and the consumer is called upon to pay for that which it is impossible for him to burn out. At and before the time the above paper was written it was usual in many cases to estimate the sulphur by oxidation of all sulphur present, and collecting the sulphuric acid by precipitation with a soluble barium salt, and then to estimate the sulphur present as sulphates by precipitation without oxidation, the difference between the two giving what was reported as "available sulphur." Then came the "bisulphide method," which consisted in dissolving out the sulphur with bisulphide of carbon, distilling off the bisulphide, and fusing the residual sulphurs. This method would give fairly accurate results were it not that tarry matters dissolve out also which are difficult to eliminate by any after operation without danger of losing sulphur.

This method was in use in my laboratory for some time, but experience showed that the results of the experiments did not show the real amount of available sulphur, there being at least two errors—first, the tarry matters dissolving out in the bisulphide of carbon used; and, secondly, if any carbonate of lime was present, its presence made no difference in the results of the analysis. It would certainly be possible to make a mixture of lime, or carbonate of lime, and spent oxide in such proportions that none, or but very little, sulphurous acid would be evolved on combustion; yet such a mixture would give abundance of sulphur—stated to be available—when examined by the bisulphide method. It is well known that in most gas

works lime is used in the purifiers, even where oxide of iron is used, and the lime and oxide being often placed in close proximity to each other for want of room, it is not very wonderful that the spent oxides should often contain carbonate of lime. In some cases lime is purposely added to the purifying material and it is certainly surprising that manufacturers agree to pay for what sulphur it is impossible to burn off, and also for tarry matters, which they are aware will not make oil of vitriol.

Sometimes the sulphur obtained from the assay of the spent oxide by the bisulphide method is remarkably pure, at other times it is very impure and cannot be properly purified without loss of sulphur. As instances the following figures are given, which show the amount per cent of pure sulphur in six different samples of the above—sulphurs weighed by another chemist, who, at my request, saved them for me from his work.

No.	A.	B.
1	90·41	90·19
2	97·60	97·52
3	97·38	97·44
4	92·66	92·74
5	98·92	98·88
6	99·84	99·93

In A the sulphur was ground up with a mixture of carbonate of soda and nitrate of soda, and projected into fused nitrate of soda in a porcelain crucible, the sulphuric acid being precipitated in the ordinary way as barium sulphate. In B the sulphur was dissolved by boiling with pure sodium hydrate, and a current of chloride passed into the solution until the oxidation was complete; the sulphuric acid so formed was treated as in A.

The bisulphide method proving so unsatisfactory, I began to look around me for an accurate method—for one which would give the real amount of available sulphur—or that amount which would be liberated by the thorough combustion of the oxide under the varying circumstances, lime or no lime, tarry matters and other oxidising substances. With this end in view it was thought necessary to thoroughly examine all the spent oxides which are to be met with in commerce, to know once for all how the various constituents were likely to behave towards the reagents to be used, and under the physical conditions to which they were to be subjected.

The spent oxides of commerce may be divided into three classes.

1. Those formed when precipitated oxides of iron are used.
2. Those formed when natural hydrated oxides of iron are used, such as bog-ochre, &c.
3. Those produced from copperas or dry copperas.

As instances of the first class may be cited the following analyses :—

	I.	II.	III.
Ferric hydrate	18·42	17·74	19·36
Sawdust	2·42	1·98	4·72
Carbonate of lime	none	none	1·04
Ammonium sulphocyanide	2·52	1·99	2·74
„ ferrocyanide	traces	traces	traces
Tarry matters	0·72	0·84	1·22
Sulphur	67·18	66·22	62·44
Matters insoluble in dilute HCl	3·66	5·47	3·76
Moisture (by difference)	5·08	5·76	4·72
	100·00	100·00	100·00

The spent oxides of the second class being produced from oxides of iron not in such a fine state of division as the first class, generally contain more ferric hydrate and less sulphur; the difference in oxide, however, does not alter the accidental constituents, such as sulphocyanide and tarry matters.

The following analyses will show the composition of oxides of the second class :—

	IV.	V.	VI.
Ferric hydrate	26·42	25·91	15·96
Sawdust	1·24	1·14	3·72
Carbonate of lime	none	1·73	0·46
Ammonium sulphocyanide	1·93	1·57	0·94
„ ferrocyanide	0·21	trace	trace
Tarry matters	1·14	0·96	0·82
Sulphur	50·12	48·70	57·41
Insoluble matters in dilute HCl	11·42	11·42	9·74
Prussian blue	trace	0·17	trace
Moisture (by diff.)	7·22	8·04	10·82
	100·00	100·00	100·00

Examples of oxides of the third class may be seen in the following analyses :—

	VII.	VIII.	IX.
Ferric hydrate	5·04	7·23	6·84
Sawdust	1·89	3·24	1·04
Carbonate of lime	none	none	none
Ammonium sulphocyanide	2·52	3·41	1·98
„ ferrocyanide	0·64	0·27	0·33
Tarry matters	1·18	0·72	0·43
Sulphur	55·74	48·76	52·46
Insoluble matters in dilute HCl	7·82	10·65	12·68
Calcium sulphate	1·43	trace	0·72
Ammonium sulphate	12·78	16·72	15·14
Prussian blue	1·74	0·22	trace
Moisture (by diff.)	9·22	8·78	7·98
	100·00	100·00	100·00

The foregoing analyses represent very fairly most of the spent oxides found in commerce; occasionally very bad ones are found, containing very large quantities of carbonate of lime or sawdust, or happen to contain very little sulphur or large quantities of moisture. The following three analyses are of samples of bad oxides :—

	X.	XI.	XII.
Ferric hydrate	20·40	8·72	10·99
Sawdust	2·16	9·76	3·18
Carbonate of lime	10·36	5·87	none
Ammonium sulphocyanide	4·72	0·76	1·18
„ ferrocyanide	traces	0·34	0·44
Tarry matters	0·67	1·04	0·55
Sulphur	32·42	42·16	36·78
Insoluble matters	16·76	20·71	12·12
Calcium sulphate	3·23	1·77	none
Ammonium „	none	0·74	1·14
Prussian blue	traces	0·64	0·21
Moisture (by diff.)	9·28	7·49	33·41
	100·00	100·00	100·00

Having the results of many analyses like the foregoing twelve in view, and after many trials and experiments, the only correct method of estimating the *available* sulphur, which could be done in a short space of time, was to make a combustion of the sulphur, thus imitating the operations of the manufacturer.

The advantages of a combustion method are self-evident, tarry matters are burnt into carbonic acid, and any carbonate of lime present retains its equivalent of sulphur, which equivalent would not appear in the report of the analysis.

There were several difficulties to overcome before the combustion method was perfected, and as the process now stands and is about to be described—in the absence of carbonate of lime and tarry matters—gives results which are practically identical with the bisulphide method.

The process has been in use in my laboratory for over six months, during which time over two hundred samples of spent oxides have been examined by it. The results have been perfectly satisfactory, therefore the bisulphide method has been discarded as not always trustworthy, because it does not always give the true amount of *available* sulphur, which the combustion process does.

In experimenting upon the process it was at first surmised that the tarry matters, sawdust, and cyanogen compounds would interfere with any process which depended upon the volumetric reduction of standard solutions, and as the first samples operated upon contained no sulphate of ammonia the unwashed sample was burnt, and the sulphur dioxide passed into diluted peroxide of hydrogen, the sulphuric acid so formed being weighed as sulphate of barium.

This was found too long and tedious a process, and the cost of peroxide of hydrogen was great; so, after numerous trials and experiments, the gravimetric process was abandoned for a volumetric one.

It would swell this paper to an unnecessary length to enter into the details of all the trials and failures performed and obtained upon this subject, therefore I will proceed to describe the combustion process at length, exactly as it is now carried out in my laboratory.

Generally the report of the analysis includes the quantities per cent of moisture, sulphate of ammonia, and sulphur. With the two first it is unnecessary to describe their estimation, only so far as it relates to this process.

5 grms. of the oxide for analysis are weighed off and dried at 100° C. till it ceases to lose weight, which generally takes about two hours. After weighing, the dried sample is transferred to a beaker and digested with hot water, then washed on to a tared filter, and thoroughly washed with water.

The filter is then placed in the drying oven until it ceases to lose weight at 100° C. When thoroughly dried it is weighed again, the weight noted, and the filtrate is used for the estimation of the ammonia, which is calculated as sulphate, though it will be seen by the analyses of the foregoing oxides that the ammonia is often combined with several other acids, and that often no sulphate of ammonia is present. The washed and dried residue is then finely ground up in a mortar, and 0·16 grm. is weighed off into a porcelain boat in a thin layer about 2 inches long, when it is ready to be placed in the combustion-tube, which has been heated to low redness for its reception.

The furnace used may be of any form—that used in my laboratory is Glaser's pattern, and the combustion-tube of very infusible potash glass lies in a packing of asbestos. The tube projects about 2 inches from each end of the furnace; one end is left open and the other is fitted with a good cork, through which passes a glass tube. Connected with this tube by a very short piece of india-rubber tubing free from sulphur is a bottle fitted with a caoutchouc stopper holding two tubes, one penetrating just below the stopper and the other reaching nearly to the bottom of the bottle. When the furnace has been heated sufficiently 60 c.c. of decinormal iodine solution are placed in the bottle and well diluted with water. The short tube of the bottle is then connected with the Bunsen pump, and a steady current of air drawn through the tube. Tht boat containing the oxide is now pushed gradually and cautiously into the tube, so that the sulphur burns slowly from the front to the back of the boat. When the flame of the sulphur has all disappeared the boat is pushed into the full red portion of the tube, and left in the current of air for about three minutes. At the end of this time the boat is withdrawn and the contents of the bottle titrated with decinormal sodium hyposulphite, when, if 0·16 grm. has been taken, each c.c. of iodine solution reduced will give the percentage of sulphur direct.

The above is the number of parts of sulphur in 100 of the residue, freed from moisture and all soluble constituents; a calculation is therefore necessary to know what the percentage would be upon the original sample in its unwashed and undried state.

In order to better describe the process the following is given, made upon a sample of good oxide, exceptionally free from tarry matters and free also from any bases likely to retain sulphur, and which, when examined by the bisulphide of carbon method, gave the following results:—

	Wet.	Dry.
Moisture	6·60	—
Sulphate of ammonia	18·30	19·60
Sulphur	42·70	45·70

5 grms. dried at 100° C. weighed 4·67 grms., which is equivalent to 6·6 per cent moisture.

The 4·67 grms. were then digested with water and washed on to a tared filter till free from ammonia. The filtrate when boiled with soda gave off ammonia sufficient to neutralise 13·9 c.c. of normal acid, or equal to 18·35 per cent of sulphate of ammonia in the wet sample. The washed and dried residue weighed 3·722 grms., and 0·16 grm. of this residue when burned in the combustion-tube gave off sulphur dioxide, which decolourised 57·1 c.c. of decinormal iodine.

From the foregoing experiments it will readily be seen that the 100 parts of the oxide experimented upon were made up as follows:—

Water	6·60	(α)
Soluble matters	18·96	(β)
Insoluble	74·44	(γ)
	100·00	

Sulphur in 100 parts of the "insoluble" .. $57·1 = \delta$

The percentage of sulphur in the moist original sample (x) is found from the formula (1).

$$(1) \quad . \quad . \quad . \quad . \quad x = \frac{\gamma \times \delta}{100}$$

and the sulphur on the dry sample from (2).

$$(2) \quad . \quad . \quad . \quad . \quad \frac{x \times 100}{\beta + \gamma}$$

Formula (1) gives:—

$$\frac{74·44 \times 57·10}{100} = 42·5$$

and formula (2)—

$$\frac{42·5 \times 100}{18·96 + 74·44} = 45·5$$

The two processes have given from the same sample o oxide the following results:—

	Bisulphide Method.	Combustion Method.
Moisture	6·60	6·60
Sulphate of ammonia (wet)	18·30	18·35
,, ,, (dry)	19·60	19·64
Sulphur (wet)	42·70	42·50
,, (dry)	45·70	45·50

The following results were obtained from spent oxides examined from time to time, and in every instance where the bisulphide method gave higher results than the combustion method, it was fully proved that there was no error in the latter, but that there was present either much tarry matter or bases which retained sulphur in combustion:—

	I.	II.	III.	IV.
A	48·34	45·31	45·46	45·28
B	52·76	51·50	51·70	51·58
C	58·84	58·60	58·76	58·81
D	42·96	41·70	41·70	41·90
E	48·46	48·29	48·33	48·14
F	49·87	49·04	49·11	48·98
G	62·38	60·12	59·96	60·22
H ..	54·77	51·71	51·50	51·60

The numbers in column I. are by bisulphide of carbon; in columns II. and III. are numbers obtained by the combustion method as before described; and in column IV. numbers obtained by the combustion of sulphur; but the sulphur dioxide was passed into hydroxyl, and the sulphuric acid weighed as barium sulphate.

It has often been said that the anhydrous oxide of iron will not take up sulphur from coal-gas; to show that this notion is erroneous is given an analysis of spent oxide produced by mixing burnt pyrites after the extraction of the copper with sawdust, and placing in the purifiers in the usual way. The oxide had been in use in a small gas works for nearly twelve months:—

Ferric hydrate	6·28
Ammonium sulphocyanide	1·56
,, chloride	0·72
Tarry matters	1·00
Moisture	16·40
Insoluble in dilute HCl	35·50
Sulphur	34·00
Sawdust &c. (by diff.)	4·54
	100·00

In conclusion I may add that the sulphur must be determined if by this combustion method in the *washed* and *dried* sample; the raw original sample must on no account be used, for when the raw sample is operated upon no two results can be made to agree, for in the first place there are present sulphates, sulphocyanides, and ferrocyanides, which are acted upon in different manners as the air current is more or less rapid, and the heat of the combustion-tube more or less intense. The sulphate of ammonia may be split up and form sulphur dioxide, or it may be simply volatilised, or both conditions may coexist and incorrect results will be obtained. Neither is it of any use to aspirate the products of combustion through a solution of carbonate or caustic soda, titrating afterwards the sulphur dioxide with decinormal iodine, for more than 30 per cent is by this means oxidised to sulphuric acid, and though this may be precipitated and weighed as barium sulphate, yet this is a much longer method, more tedious, and not more accurate, so that for all technical purposes where the amount of *available* sulphur is required, the only process at once rapid, easy, and accurate is the method of combustion as given above, burning the sulphur into sulphur dioxide, absorbing this in decinormal iodine largely diluted with water, and titrating the excess of iodine solution with decinormal hyposulphite.

Barton Arcade, Manchester,
October 9, 1877.

ON THE

EXISTENCE OF A CONNECTION BETWEEN ELECTRICITY AND THE MOTIONS OF CAMPHOR ON WATER.*

By P. CASAMAJOR.

You are doubtless familiar with the singular motions of camphor when placed on the surface of water, which are of such extraordinary nature as to attract the attention of even the most careless observer. Very eminent philosophers have studied these wonderful gyrations, but little has resulted from their labours to explain the cause of this phenomenon. Among those who have worked on the subject we find the great Volta; we also find Venturi, Brugnatelli, Fourcroy, Biot, Matteucci, and Dutrochet. Mr. Charles Tomlinson, who has given great attention to the subject, published in 1863 a work,† in which he gave a full account of previous labours of eminent physicists and chemists on these motions of camphor, to which he added many interesting experiments of his own. I cannot do better than advise those who wish to study the history of the subject to consult this excellent book.

* Read before the American Chemical Society, October 4, 1877.

† "Experimental Essays. I. On the Motions of Camphor on the Surface of Water." By Charles Tomlinson. Virtue, Brothers, and Co. London: 1863.

I find in this work that in 1748 Romieu communicated to the Royal Society of Montpellier his observations on camphor, in which he advanced the idea that electricity is the cause of these singular motions. Romieu states that camphor does not rotate on the surface of water placed in vessels of iron or copper, but the experiment succeeds very well in those made of glass, sulphur, or resin. He also states that while camphor is spinning in these vessels it is arrested if the surface is touched with the finger, with iron or brass wire, or a rod of wood; but glass, sealing-wax, or sulphur cannot arrest these motions.

This idea that the motions of camphor on water are due to electricity has met with the disapprobation of all subsequent observers, among whom may be found the names of men who are famous in the history of electricity. Notable among these is Alessandro Volta, who made several experiments to show that electricity had nothing to do with these motions.

Now, I propose to show you this evening that there is an evident connection between electricity and these motions of camphor, and, as Volta and other eminent philosophers are unanimous in asserting that there is no such connection, I may be allowed to say that in the experimental sciences there is no authority of as much value as a fact, if the fact has been well observed. I propose, therefore, to show you the facts, and you are to be the observers. These facts naturally lead to the conclusion that the remarkable motions presented by camphor on the surface of water are electrical phenomena. I am not prepared at present to go beyond presenting these facts, and drawing from them what seems an evitable conclusion. The phenomena which accompany these motions of camphor are very complex, and they have stubbornly resisted every attempt on my part to bring them under a general theory. I am in the hope, however, that what I have to present this evening may serve to elucidate this interesting subject.

Camphor is not the only substance which moves spontaneously on the surface of water. Volta discovered the same property in benzoic and succinic acids. Others have added the stearoptenes of essential oils, the butyrates of soda and potassa, carbolic acid, and citric acid;* even pieces of cork soaked in ether will exhibit the same phenomenon for a short time. Naphthalen is mentioned in some books as possessing the same property, but I have found that it has not. These substances, with the exception of the stearoptenes, are heavier than water, and they are with difficulty kept afloat: they are also more soluble than is quite convenient for the experimenter. As they behave exactly in the same manner as camphor towards electricity, I will confine my remarks to camphor, as I have almost entirely confined my experiments to this substance.

If we throw pieces of camphor in water they rise to the surface, and, if the conditions are favourable, they will move on the water as if gifted with life. The larger fragments have slower motions than the smaller, which is due to their greater inertia, for if we sprinkle the surface of the water with lycopodium, after the ingenious idea of Mr. Tomlinson, we will find that the currents that set from the larger pieces are stronger than from the smaller. The mobility of the liquid being greater than that of the larger pieces the liquid moves away from the camphor. The shapes of the fragments of camphor have a great influence on the rapidity of their motions. A spherical piece will exhibit very little motion, while an elongated piece of the same volume, terminated by two pointed pyramids,† will rotate with the greatest energy.

Very often the conditions under which the motions take place do not exist, and camphor remains perfectly quiet on the surface of the water. It has generally been supposed that when this happened the surface of the water

* Hence, as suggested by Tomlinson, a quick way of distinguishing citric from tartaric acid, which does not possess this property.

† As camphor breaks up very readily while being cut, I have agglomerated it into cylinders by compressing it in a Plattner's ore crusher. Thus compressed it stands handling much better.

was covered with a film of dirt—either oil, dust, or something else—which, for some reason, prevented the gyration from taking place. If, however, we keep the same water in a glass for several days, and place in it at different times fragments of the same pieces of camphor we will sometimes have motions, and at other times not, which points to the conclusion that these irregularities are independent of the camphor, of the cleanliness of the water surface, and of the vessel that holds the water.

In the daytime the motions are more apt to take place than after sundown. Also when the weather is bright, or when it storms, than when the sky is cloudy and the air damp, but without any presages of a storm. In many books we find that these motions of camphor on water are due to evaporation, although some add the truthful remark that this explanation is not satisfactory. When I began these researches I tried several times to determine these motions by heating the water, but without success; while at other times the camphor spun in a lively manner on the surface of ice-water. Evaporation was clearly not the cause.

At this stage of the matter a gentleman, who is one of our Associates, communicated to me an observation, which I have already mentioned, that if fragments of the same piece of camphor are placed on several successive days in the same volume of water, sometimes there is motion and sometimes not. It was suggested at the same time that perhaps magnetism or electricity had something to do with it.

Rejecting magnetism as improbable, and not being aware at the time of the disapprobation by eminent philosophers of the existence of any connection between the motions of camphor and electricity, I made the following experiments, which I propose to repeat before you after reading this paper.

Having before me a beaker-glass holding water, on the surface of which small fragments of camphor were dancing with great energy, I rubbed a clean glass rod with flannel, and dipped the rod in the water, when I was surprised to see all the small pieces of camphor suddenly reduced to immobility. This experiment was repeated several times with fresh portions of water and of camphor, and always with the same result. Subsequently, the same glass stirrer, rubbed with tin-foil to render it electrically neutral, failed to produce any effect.

In the next place, the same experiment was tried with a piece of vulcanite previously rubbed with flannel, but the motion of the camphor did not stop, and they even appeared to increase in intensity. To test whether this was the case, I was led to stop the motions with a glass rod, and then touch the water with the excited vulcanite. You may judge of my pleasure when the fragments of camphor began again their gyrations as the vulcanite touched the water. I afterwards ascertained that a rod of shellac or of sulphur, had the same effect as one of vulcanite.

The first deduction I made from this was that positive electricity stops these motions of camphor, while negative electricity increases their intensity. This deduction, however, was erroneous, as I subsequently found that if, after the motions are stopped by an excited glass rod, it is taken out, wiped dry, and excited again, and dipped in the water; and if the same operation is repeatedly gone over, the motions recommence, and increase in intensity every time the excited glass rod is placed in the water. I also found that motions due to positive electricity may in their turn be stopped by dipping in the water an excited rod of vulcanite.

This requires a word of caution, as by rubbing glass very little positive electricity is obtained, when compared to the negative electricity which may be had, in the same manner and in the same time, from vulcanite, shellac, or sulphur. This difference requires that a negatively electrified rod be used with great nicety, as otherwise we bring in contact with the water more negative fluid than is necessary to neutralise the positive electricity, and, as a consequence, the water becomes at once negatively electrified, and the motions continue without interruption.

When the passage from one kind of electricity to another is very gradual there always occurs an intermediate stage at which, if several pieces of camphor are on the water, they coalesce. Afterwards, when the water becomes more decidedly electric, these pieces part company, sometimes in quite a violent manner. A point of great importance to note is that when the surface of the water is electrically neutral, and pieces of camphor adhere to one another, they remain for a long time without perceptibly diminishing, while when they are in active motion they wear away in a much shorter time.

Gentlemen, I do not feel that I sin against any rule of the strictest logic when I conclude from the facts which I have mentioned that there is a connection between electricity and these motions of camphor. As to the cause of these motions, it resides in the camphor itself, and the explanation of the phenomenon must be found in some property possessed by certain substances, of which camphor is the type, by virtue of which water which has been electrified dissolves them with greater rapidity than when not electrified. If a piece of camphor is held fast on the surface of the water, and lycopodium is sprinkled over this surface, as was done by Mr. Tomlinson, we will see currents flowing outwardly from the camphor. This may be explained by supposing that the water, holding camphor in solution, has the same electricity as the camphor itself. If the fragments are very small and are free, their great mobility allows them in their turn to be repulsed by the surface of the water, which remains comparatively stationary. When we hold fast on the surface of water a piece of camphor with an irregular outline we may see, by means of lycopodium, that the currents flowing outwardly from the camphor are very uneven in different directions. The inequality of the currents must, when the camphor is set free, determine its motion in a direction opposite to the resultant of these currents.

The enquiry which now presents itself relates to the nature of the remarkable property which enables some organic substances—such as camphor, benzoic acid, and others which I have mentioned—to move on the surface of water when it is electrified. Dutrochet ascribed these motions to a new force, which he called the *epipolic* force. This amounted to giving up the problem. For my part, although I have endeavoured to discover the nature of this property, the results which I have obtained are as yet too meagre and too contradictory for presentation before this Society. I do not despair, however, at some future day to present you with results worthy of your attention.

Liebig Memorial.—Immediately after the death of Liebig, at the suggestion of the German Chemical Society, an International Committee was formed for the purpose of preserving to future generations in a visible form the memory of the great investigator. This Committe has now so far advanced in its preparations as to be able to proceed to the accomplishment of this important task. For this object an Executive Commission has been entrusted by the International Committee with the necessary powers. Accordingly all sculptors are invited to participate in a general competition. The monument is to be erected in the Maximiliansplatz in Munich, which is laid out as a garden. The sum of 120,000 marks is allotted to the erection of a bronze statue upon a richly decorated pedestal, for the artistic adornment of which Liebig's varied activity affords most appropriate materials. The Executive Commission offers for the best of the models sent in a prize of 2000 marks, for the second a prize of 1500 marks. The competitors are requested to choose such a scale for their models that the figure, considered as standing upright, should be 40 centimetres in height. The models, which will be publicly exhibited first in Berlin and then in Munich, must be sent in between the 1st and 15th of June, 1878, addressed to Kastellan der Königl. Akademie der Künste, 38, Unter den Linden, Berlin.

PROFESSIONAL ORGANISATION OF CHEMISTS.

The long correspondence which appeared in our columns on the necessity of an organisation among chemists, similar to those existing in other professions, will still be fresh in the memory of our readers. We have at last the pleasure of announcing that, after long and anxious deliberation, definite steps are about to be taken towards the desired end. That the scheme selected is beyond the reach of criticism its promoters do not pretend, but to their best belief it is, if not the best conceivable, at all events the best practicable. Perhaps, theoretically speaking, the orthodox procedure would have been to have called a general meeting of the whole profession to have laid down certain main principles, and committed their elaboration to a council then and there elected. But there is every reason to fear that such a meeting would have been obliged to separate *re infecta*. In consequence a very different plan has been pursued. A number of chemists—including some who are generally recognised as among the heads of the profession—have associated themselves under the title "The Institute of Chemistry of Great Britain and Ireland." This Association will be enrolled under the "Companies Act" of 1867, but will be debarred by one of its articles from paying, directly or indirectly, any dividend or bonus to any of its members. The Association is to consist for the present of 500 members, who alone are qualified to vote at its general meetings and to exercise any share in its administration. The ordinary government of the Institute is vested in a Council, consisting of a President, six Vice-Presidents, a Treasurer, and twenty-seven Ordinary Members. These offices are already filled, and the present Council is to continue in office "until the first General Meeting, which shall be held after the end of the second year after the Registration," and will consequently have in their hands the power of organising the Institute and launching it on its career.

Besides Members, the Institute will comprise Fellows and Associates. It is remarked that "No one shall be a Member of the Association unless he be a Fellow thereof, but the Council may admit persons to be Fellows who are not Members; such Fellows, nevertheless, shall have none of the rights of Members."

For the first six months after the registration of the Association the Council may admit Fellows and Associates, either as Members or non-Members, upon such evidence of fitness as the Council may deem sufficient, or without any such evidence, at their discretion. After the said first six months, and during the then succeeding thirty calendar months, the Council shall require from any candidate for a Fellowship the following evidence of qualification:—"That he is not less than twenty-four years of age; that he has passed through a course of three years' training to the satisfaction of the Council in Theoretical and Analytical Chemistry and Physics, and has subsequently been engaged for three years either as Assistant to a Chemist of repute or as a Professor or Demonstrator of Practical Chemistry at some known University, College, or Medical School, or as a Chemist in a technical industry; or has, after three years' training as above, conducted and published an original research of sufficient merit, in the opinion of the Council, on some chemical subject requiring practical work. Or that he has been trained and occupied in other ways which, in the opinion of the Council, are equivalent to fulfilling the conditions stated in the preceding article."

The document then becomes somewhat obscure. A second set of qualifications for Fellows succeed, which may possibly apply to such persons as apply for Fellowships after the six and the thirty months have elapsed. Such persons, if we understand rightly, are to show that they are not less than twenty-four years of age; that they have been admitted to the Institute as Associates, and have since been engaged for three years in the study and practice of Applied Chemistry in a manner satisfactory to the Council.

What are to be the qualifications of Associates who apply for admission during the first six months does not distinctly appear. After the first six months, and during the succeeding thirty months, such persons will be required to show that they are not less than twenty-one years of age; and have passed a course of three years' study of Theoretical and Analytical Chemistry, Physics, and Elementary Mathematics, satisfactorily to the Council After the thirty months candidates for Associateship will have to show that they have been trained and educated "in such a manner as the Council may from time to time direct, and, in addition, must have passed an examination approved by the Council in Chemistry, Physics, and Elementary Mathematics, conducted by a recognised University, College, School, or Society, or has passed such other examination as shall have been prescribed by the Council." Every Fellow is to pay an entrance-fee of five guineas and an annual subscription of two guineas. Every Associate shall pay an annual subscription of one guinea. Both Fellows and Associates on admission will be required to sign the following declaration:—"I do solemnly and sincerely declare that while a Fellow (or Associate) of the Institute of Chemistry I will observe the Regulations thereof; that I will demean myself honourably in the practice of my profession, and to the utmost of my power maintain the dignity and welfare of the Institute."

Such is a brief sketch of the proposed organisation which its promoters now wish to submit to the judgment of their professional brethren. The scheme, it will be observed, possesses considerable elasticity, and will doubtless undergo modifications after it has been put to the test of actual experience.

TRADE IN DIPLOMAS.

According to the *Allgemeine Chemiker Zeitung*, advertisements have appeared in many German political papers offering assistance in obtaining degrees, passing test-examinations, &c. Our contemporary, to sound the matter, wrote under a feigned name to the address given in the advertisement, asking for assistance to obtain a doctor's diploma in the natural sciences. He received the following reply:—

"To your respected inquiry of the 17th inst., I beg to reply that we can furnish you with a scientific treatise of the extent of a good dissertation, in the strictest confidence on our part, within two months from date of order for the fee of 450 marks (£22 10s.). Half this sum is payable at the date of the order, the balance on delivery. We guarantee the excellence of the work with three-fourths of the fee. The following treatises in zoology can be delivered at once:—

"(1.) The skull of *Cynocephalus niger* considered with reference to theory of evolution, with the accompanying anatomical preparations.

"(2.) On the Branchiopoda, especially such as occur in Germany.

"The undersigned gives his word of honour (!) for the originality of the essays."

The signature we suppress. Dr. Krause, the editor of the *Chemiker Zeitung*, remarks:—"Whilst in other cases offers of this nature are more or less distinctly fraudulent, it is in the present instance doubtful how a diploma-producing association, consisting apparently of learned men, can stoop to work out honours for a stranger, well knowing that he will be required to make a declaration tantamount to an oath that the dissertation is his own production."

NOTICES OF BOOKS.

A Treatise on Chemistry. By H. E. ROSCOE, F.R.S., and C. SCHORLEMMER, F.R.S., Professors of Chemistry in Owens College, Manchester. Vol. I. The Non-Metallic Elements. London: Macmillan and Co.

"It has been the aim of the authors," as we are told in the Preface, "to place before the reader a fairly complete, and yet a fair and succinct, statement of the facts of modern chemistry, whilst at the same time entering so far into a discussion of chemical theory as the size of the work and the present transition state of the science permit." The work commences with a historical introduction, upon which we may fairly congratulate the authors. The gradual development of the science is traced with great clearness; the discoveries which have served as turning-points are thrown into bold relief, without being disconnected from preparatory trains of thought and research, and the respective merits of the great masters of the past are discussed with a judicious impartiality. Thus while rendering full justice to the eminent merit of Lavoisier, and recognising his part in the foundation of modern chemistry, they admit that the charges brought against his good faith, especially as regards the discovery of oxygen, are "unfortunately but too well founded." Whether the countrymen of the great French chemist will acquiesce in the verdict thus pronounced by a German and an Englishman is, however, a different question.

In the account of the phlogistian controversy we find a passage which deserves attention:—"In considering this great discussion from our present point of view, we cannot but recognise in the phlogistic theory the expression of an important fact, of which, however, the true interpretation was unknown to the exponents of the theory. The phlogistonists assert that something, which they term phlogiston, escapes when a body burns; the antiphlogistians prove, on the other hand, that no escape of material substance then occurs, but that, on the contrary, an addition of oxygen (or some other element) always takes place. In thus correcting from one aspect the false statement of the followers of Stahl, Lavoisier and his disciples overlooked an interpretation which may truly be placed upon the statements of the phlogistonists, for if in place of the word 'phlogiston' we read 'energy' this old theory becomes the expression of the latest development of scientific investigation. We now know that when two elements combine, *energy*, generally in the form of heat, is evolved, whilst in order to resolve the compound into its constituent elements an expenditure or absorption of an equal amount of energy is requisite."

Passing from this historical survey to the body of the work, we are first struck with the number and the excellence of the illustrations, which in clearness and minute accuracy may be considered unrivalled. These merits belong not merely to the figures representing apparatus as employed in the laboratory, but to those explanatory of manufacturing plant on the large scale. As an instance we must refer to the account given of the manufacture of sulphuric acid. Here we find, first, a general or bird's-eye view of a sulphuric-acid works, and afterwards a set of figures drawn to scale, and giving the plan, the longitudinal section, and a sectional elevation in another direction indicated "of one of the most complete forms of sulphuric-acid works now in use in this country." In addition, these illustrations show the arrangement of the nitre-pots in plan and section, the improved arrangement of platinum stills as devised by Messrs. Johnson and Matthey, and the plan of a rectifying-house where the process of concentration is conducted in glass vessels. It is impossible to overrate the value of this feature in the work before us. To be able to direct the arrangement of plant for any particular chemical manufacture is one of the most important duties of the practical chemist. No one else can fully understand the requirements of the case or decide what is necessary for efficient working. Hence, unless the chemist is able to direct the engineer or the architect—to explain to them distinctly what is wanted—a misarrangement of plant is very probable. This part of the training of chemists has been hitherto, in England, much neglected. We have seen instances of young men who, on receiving an appointment in some chemical manufactory, were utterly strange to its arrangement. They were well versed in chemical theory, careful and expert analysts, but their ignorance of manufacturing work and of its conditions was at once visible to every labourer in the establishment. Such ignorance delights all rule-of-thumb men,—who are yet very common in chemical works in the capacities of foremen, managers, and even masters,—brings Science into contempt, and thus retards the development of our national industry. We will venture to say that the student who has carefully examined the figures relative to the manufacture of sulphuric acid in the work before us, and read the accompanying descriptions, will be in no danger of stultifying himself if called upon to take part in the management of a sulphuric-acid works.

The descriptions of other important manufacturing processes are rendered intelligible in a similar manner. Indeed it is not too much to say that, in virtue of its style of illustration alone, the work of Professors Roscoe and Schorlemmer may claim a place along with and complementary of the great systematic productions of Watts and of Gmelin, with the additional recommendation of being brought down to the most recent state of the Science. One slight objection we must, however, take as regards some of the figures of manufacturing plant. In certain cases—*e.g.*, the manufacture of sulphuric acid—the appended scale is on the metric system, whilst in the diagrams relative to hydrochloric acid it is given in feet. The adoption of one uniform standard would have obviated possible mistakes.

As regards the text of the book before us, all who are acquainted with the smaller works of Prof. Roscoe will consider his name a guarantee for clearness of arrangement and exposition. The most recent results of experimental research, as far as authenticated, and the most advanced theoretical views are here embodied. Fulness without prolixity has been successfully aimed at, and references to original memoirs direct the student who may require details for which the scope of the work is insufficient. An important feature—which may be foreseen from our remarks on the illustrations—is that the work recognises no gulf between theory and practice, and deals with the chemistry of the factory as well as with the more refined operations of the laboratory. How great a boon this must prove to the student, and ultimately to the manufacturer and the nation, does not require to be further shown. The authors do not consider the list of the supposed elementary bodies completed, nor do they hold that these bodies are necessarily incapable of decomposition.

Great credit is due to the publishers for the excellent style in which so admirable a work is presented to the scientific public.

CORRESPONDENCE.

SPECIFIC GRAVITY APPARATUS.

To the Editor of the Chemical News.

SIR,—It appears that the specific gravity apparatus described in the CHEMICAL NEWS, vol. xxxvi., p. 168, is not new. It is described as Hare's hydrometer in *Bird and Brooke's Nat. Phil.*—I am, &c.,

JAMES TAYLOR.

Metallurgical Laboratory, Owens College,
October 17, 1877.

SPECIFIC GRAVITY APPARATUS.

To the Editor of the Chemical News.

SIR,—One charge may be brought against the younger chemists of the present day—that of not reading up the records of past work done by their predecessors. Were this done more punctually we should have fewer reproductions of old inventions. For instance, the "Simple Specific Gravity Apparatus for Liquids" (only much improved), of Mr. James Taylor, appeared in the CHEMICAL GAZETTE, vol. ii., p. 125, and dated January 9, 1844. Thus, whatever merits it may possess of utility, it cannot lay claim to more novelty than thirty-three years will allow.—I am, &c.,

P. H.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 15, October 8, 1877.

Apparatus for Measuring the Evaporation-heat of Liquids.—M. Berthelot.—This apparatus cannot be described in an intelligible manner without the aid of the accompanying illustration.

Determination of the Heat of Fusion.—M. Berthelot.—The solidification of liquids, and especially of the hydrocarbons, is rarely as sharply defined as that of water, many bodies solidifying gradually, and preserving a soft paste-like condition during a certain interval of temperature. The measurement of the heat of fusion becomes then very difficult, for it is not possible to confine ourselves to determining the heat given off by the substance whilst it is solidified at a stationary temperature, as the definitions of physicists require. The author has verified the observation that chloral hydrate solidifies and crystallises at an apparently fixed temperature of 46°, but he has also found that the heat thus liberated during the solidification of 1 grm. of chloral hydrate amounted merely to + 17·6 calories, whilst the heat absorbed during the fusion—effected likewise at 46°—is + 33·2 calories, or nearly double. The two phenomena are not reciprocal when they succeed each other immediately, and only become so when they are separated by a very considerable time, which in the present case amounts to several months. The author's method consists in bringing the body under examination to a certain final condition, proved to be identical by thermic experiments; a demonstration the necessity of which had not struck early observers. As regards chloral hydrate, this identic final condition, suitable for defining the different states of this body, was obtained by dissolving it at a given temperature and in a constant quantity of water.

Remarks on the Variations of Temperature liberated by the Union of Water and of Sulphuric Acid at Different Temperatures.—M. Berthelot.—The union of $S_2O_8H_2$ with H_2O_2 liberates approximately the same amount of heat at every temperature bordering upon 15°. For the union of $S_2O_8H_2, H_2O_2$ with H_2O_2 there is an increase of 112 calories between 10° and 24°.

The Ratio which should exist between the Diameter of Electro-magnetic Nuclei and their Length.—M. Th. du Moncel.—For equal circuit-resistances the diameters of an electro-magnet should be proportionate to the electromotive forces. For equal forces these diameters should be inversely as the square root of the resistance of the circuit, including the resistance of the battery. For equal diameters the forces should be proportional to the square roots of the resistances of the circuits. For a given electromotive, and with electro-magnets placed in their maximum conditions, the forces of the batteries which ought to actuate them should be proportional to the square roots of the resistances of the circuit.

Pyrogenous Decomposition of the Hydrochlorate, Hydrobromate, and Hydriodate of Trimethylamin; Novel Characteristic of the Methylamins.—M. Camille Vincent.—The production of methylic chloride, bromide, and iodide by the pyrogenous decomposition of methylamin hydrochlorate, hydrobromate, and hydriodate is a new characteristic of these compound ammonias.

Iodide of Starch.—M. Bondonneau.—The iodide of starch is a definite compound, its composition being represented by the formula $(C_{12}H_{10}O_{10})_3I$. It is decomposed, with regeneration of the original starch, by all sources of nascent hydrogen, and is again produced by the limited action of oxidising agents in the cold, even by the mere action of the atmosphere. Except present in excess, iodine is not eliminated by its solvents, such as potassium iodide, benzol, carbon bisulphide, &c., except alcohol, whilst these solvents separate it from the red compound which it forms with dextrin *a*. If kept suspended in water for a year it is slightly decomposed; a portion becomes soluble in water, which then contains dextrin *a*, coloured red by iodine, and hydriodic acid, but no glucose. The insoluble portion retains the same composition.

Description of the Meteorites of Rochester, Warrenton, and Cynthiana, fallen respectively December 21, 1876, Jannary 3 and 23, 1877, with Remarks on Former Falls of Meteorites in the Same Region.—Lawrence Smith.—These three falls of meteorites have taken place within a period of thirty-two days, and within a tract of country of about 2° lat. by 6° lon. They differ, nevertheless, in their mineralogical constitution, none of them belonging to the most common type. The Rochester meteorite, though apparently very large, seems to have been dissipated in small fragments. The portion found at Rochester did not weigh more than 400 grms. Its texture is globular. It consists of 46·8 per cent of solubl and 53·2 of insoluble matter; its specific gravity is 3·55, and it contains minute grains of nickeliferous iron. Of the Warrenton meteorite from 5 to 7 kilos. have been preserved. Its specific gravity is 3·47, and the proportion of metallic grains is very small. The proportion of the constituent minerals is about as follows:—

Peridote	76·0
Bronzite and pyroxen	18·0
Nickeliferous iron..	2·0
Troilite	3·5
Chrome iron	0·5

The weight of the Cynthiana meteorite is about 6 kilos. Its specific gravity is 3·47. From its chemical analysis the following mineralogical composition has been adduced:—

Periodite	50·00
Bronzite	38·00
Nickeliferous iron	6·00
Troilite	5·50
Chrome iron..	0·52
	100·02

Of the twelve falls of meteorites, of which specimens have been collected in the United States during the past eighteen years, eight, representing more than 1000 kilos. of matter, have fallen in the regions of the prairies of the West, and on a surface not exceeding one-eighth of the extent of the United States. This cannot be explained by the assumption that this region is more populous, and that there are consequently more observers.

Synthesis of Benzoic Acid and of Benzophenon.—MM. Friedel, Crafts, and Ador.—The process devised by the authors, although yielding chloride of benzoyl, and consequently benzoic acid, does not lead to a practical method for the preparation of this acid, but it enables benzophenon to be obtained in any quantity. Oxychloride

of carbon was prepared in the ordinary manner by causing chlorine to act upon carbonic oxide exposed to the sun. The excess of chlorine was removed by passing the gas, still in sunshine, into benzol and then over zinc-turnings. The gas traverses a series of bottles containing benzol mixed with aluminium chloride. The process lasts from six to twenty hours. At the end, each of the bottles, especially the first, contains benzophenon in solution, which is isolated by treatment with water to remove chloride of aluminium, and by distilling the benzol after washing with potassa. In these reactions benzoic acid was obtained merely in traces.

NOTES AND QUERIES.

Soda-Ash Manufacturers—A correspondent wishes to procure as complete a list as possible of the French and German soda-ash manufacturers.

MEETINGS FOR THE WEEK.

THURSDAY, Nov. 1.—Chemical, 8. "On some Hydrocarbons Obtained from the Homologues of Cinnamic Acid," by W. H. Perkin, F.R.S. "On Anethol and its Homologues," by W. H. Perkin, F.R.S. "On Two New Methods for Estimating Bismuth Volumetrically," by M. M. P. Muir.

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THE CHEMICAL NEWS.

Vol. XXXVI. No. 936.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.
(Continued from p. 188.)

Phosphorus and Matches. By Dr. Anton von Schrötter, Master of the Imperial Mint at Vienna.

Few substances are so calculated to excite our interest from every point of view so decidedly as phosphorus. Its relations especially to the organic world claim especially our whole attention.

This element, discovered nearly two centuries ago by Brand and afterwards described by Kunkel, has been therefore the subject of many investigations, and yet many of its properties are even yet not satisfactorily understood.

Phosphorus was first obtained from human urine, and a hundred years afterwards it was shown by Gahn to be an essential constituent of bones. From this fact its universal diffusion in nature might have been inferred, but it has been only of late demonstrated that not merely most substances found on the earth's surface contain phosphorus, but that it is present in most springs, in all rivers, in the sea, and even in the atmosphere (Barral), although but in slight traces. In fact upon a soil free from compounds of phosphorus no plant could grow. In this respect, therefore, phosphorus ranks among the elements necessary for building up the vegetable and animal body, like oxygen, nitrogen, carbon, hydrogen, chlorine, sulphur, iron, calcium, &c.

Let us now, as far as our immediate purpose allows, consider the properties of phosphorus more closely.

The only kind of phosphorus which was known up to 1848, and which exclusively occurred in trade, and is still known as "ordinary," is a yellow translucent, and, when recently prepared and preserved from the action of light, perfectly limpid body, brittle at low temperatures, but assuming at 15° C. the consistence of wax. Notwithstanding this cerous consistence it still possesses a perfectly crystalline texture, as may be readily perceived by exposure for some time to the action of dilute nitric acid, which attacks it slightly, leaving a surface like that exhibited by tin after treatment with a dilute acid. The single crystals obtained from solvents are decidedly octahedra, exactly agreeing in appearance with common phosphorus, which may therefore justly be called the octahedral. Mitscherlich, however, has observed phosphorus crystallised in dodecahedra.

On exposure to a moist atmosphere phosphorus is luminous in the dark in consequence of a very gradual oxidation and formation of phosphorous acid, which gradually passes into the phosphoric. At the same time a small part of the uncombined oxygen is converted into the modification known as ozone.

The phosphoric vapours hereby diffused exert a very poisonous action if inhaled, producing a disease known as phosphorus necrosis, which begins with the disintegration of the jaw-bones and ends with their total destruction, and under which ill-fed and scrofulous persons sink with peculiar rapidity. Phosphorus introduced into the stomach acts likewise as a violent poison.

With regard to its chemical behaviour phosphorus must be placed in the same group of elements as nitrogen, arsenic, antimony, and perhaps some other of the simple bodies.

If preserved under water and exposed to daylight ordinary phosphorus is covered with a white crust which gradually becomes detached. The nature of this body was for a long time doubtful. Baudrimont,* however, has shown that this crust is formed only under access of oxygen, and possesses all the attributes of ordinary phosphorus, whence we can scarcely doubt that it is merely common phosphorus which, assisted by the presence of the water, crumbles away from the sticks corroded by oxygen.

We may here also refer to the long-known, so-called black phosphorus, which, according to Thénard, may be obtained by rapidly cooling phosphorus—previously often distilled—an operation which, be it remarked, has never succeeded in the hands of the writer of this report. According to Blondlot† phosphorus also becomes black when cooled slowly, but it must be perfectly pure and limpid. The black colour is said to depend upon a black body, very minute traces of which are mixed with common phosphorus, which is left behind on solution in carbon bisulphide and passes over first on distillation, so that the last drops are colourless. Black phosphorus is rather softer than the ordinary kind, but is otherwise scarcely distinguishable. The nature of the black substance accompanying ordinary phosphorus, the formation of which is said to be promoted by mercury, though the latter element forms no part of its composition, is as yet unknown. It may be, as Blondlot supposes, a peculiar modification of phosphorus or a mere impurity.

Since 1848 an allotropic modification is met with in commerce under the name of *red*, or, preferably, as it is never a pure red and varies in colour according to circumstances, *amorphous* phosphorus. This form differs from the octahedral phosphorus in its most important attributes in a degree almost as great as do the allotropic modifications of carbon—soot, graphite, and diamond—among themselves.‡

Amorphous phosphorus in compact pieces is an opaque reddish brown substance of imperfect metallic lustre, but where recently broken almost of an iron black. It is brittle, easily broken, and exhibits a perfectly conchoidal fracture with sharp edges. Its sp. gr. is 2·105; in hardness it lies between calcareous spar and fluor-spar. The colour of the powder, and consequently of the streak, is reddish brown, exactly resembling that of ignited ferric oxide, otherwise known as colcothar.

Amorphous phosphorus is tasteless and inodorous, insoluble in all liquids which dissolve the octahedral variety, and consequently not poisonous. If taken into the stomach in considerable quantity it is excreted unchanged, and resists, therefore, the powerful oxidising process in the animal body.

It is absolutely incapable of ignition by friction, and is therefore portable without danger. As the lumps, however, generally contain some ordinary phosphorus in

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

* Baudrimont, *Comptes Rendus*, lxi., 857, 1866; *Zeitschr. f. Chem N. F.*, ii., 31, 1866.

† Blondlot, *Comptes Rendus*, lx., 830; *Gmelin Handbch. der Chemie* (Kraut's edition), i. Abth., 2, 103.

‡ In the Official Report on Group III., Section 5, published by the General Direction of the Vienna Exhibition, occurs on p. 3 the following passage:—"Shortly after the non-poisonous and sparingly combustible red modification of phosphorus had been discovered *in Schrötter's laboratory*, &c." This passage, if it is to be conformable with the truth, should read: "Shortly after the non-poisonous modification of phosphorus had been discovered *by Schrötter*. I am therefore, at the lapse of twenty-seven years, once more compelled to explain that no one who at that time was working in my laboratory has a claim to any even remotest share in this discovery. I observed the first facts relative to this matter in 1845, on which communications may be found in the *Reports of the Sessions of the Imperial Academy of Science of Vienna*, Bd. i., p. 25, and in the *Memoirs*, Bd. i., p. 1., and ii., 127. Also in the *Reports of Sessions*, Bd. i., p. 425, Bd. iv., p. 59, and p. 150. Other matter connected with this subject has been collated with historical accuracy in the "Reports by the Juries," Class ii., Sect. A. of the London Exhibition of 1862, drawn up by A. W. Hofmann. See art. "Phosphorus," p. 93.—A. v. S.

small portions they have to be forwarded in water, since they might otherwise take fire if broken or rubbed. But even then the combustion proceeds very slowly. In the form of powder amorphous phosphorus may be conveyed in tin boxes without any danger.

As commonly met with in trade the pulverulent amorphous phosphorus contains likewise small quantities of ordinary phosphorus—from 0·6 per cent downwards, according to Fresenius. It is therefore slowly oxidised on exposure to the air and has an acid reaction.

It has been also maintained that amorphous phosphorus, even in the absence of any intermixture of the ordinary variety, is slowly oxidised in the air. This is, however, doubtless an error, since the writer has preserved pure amorphous phosphorus for years spread upon paper and freely exposed to the air without any trace of an acid reaction becoming perceptible. It is still, however, possible that there are circumstances not yet ascertained in which amorphous phosphorus, even in the absence of any admixture of the octahedral kind, may become acidified by the air. Such a behaviour, though often occurring, by no means ranks among the normal attributes of this modification of phosphorus.

In addition to ordinary phosphorus and phosphorous acid, the amorphous phosphorus of commerce contains, inclusive of water, 4·622 per cent of other impurities, amongst which is always found graphite, derived from the iron vessels in which the preparation takes place.

For ignition amorphous phosphorus requires a temperature of at least 240°. In nitric acid it dissolves on account of its state of subdivision, far more readily than the common variety, because the latter, as a fused mass, offers a much smaller extent of surface for the attack of the acid. Chlorine which combines with common phosphorus with ignition has no action upon the amorphous modification. If heated in a rapid current of chlorine it burns with a yellow luminous flame.

The products of the reaction of various substances upon the two modifications of phosphorus are exactly identical, a circumstance not observed in case of other elements occurring in allotropic forms; *e.g.*, carbon, according to the researches of Brodie, Berthelot, and Stingl.

The conversion of common phosphorus into the amorphous state is effected by exposure to light or to the prolonged action of a temperature of 240° to 250°. The transformation may be effected at 215°, but more slowly. At 260° re-conversion begins into ordinary phosphorus, the boiling-point of which, under average pressure, is about 290°. The transition from one allotropic state to the other can be more readily shown in the case of phosphorus than in that of any other element. All that is required is a glass tube closed with mercury and with several bulbs blown on its horizontal limb. Some common phosphorus is placed in the first bulb at the end of the tube, which on the application of heat ignites and consumes all the oxygen contained in the tube. The residue of the phosphorus is driven into the second bulb, converted there by cautious heating into the amorphous variety, and can then again be distilled into the third bulb in the state of ordinary phosphorus.

In 1865 Hittorf,[1] in a very valuable dissertation which essentially enlarged our knowledge of phosphorus, described a substance which he obtained on exposing amorphous phosphorus along with lead to a red heat in an exhausted glass tube. After cooling, black crystalline leaflets of a metallic lustre were found on the surface of the lead, and were regarded by Hittorf as phosphorus in a new allotropic modification, which he designated as the "metallic crystalline." It would be out of place to enter here upon a detailed examination of Hittorf's interesting observations, but mention must be made of the fact that common phosphorus exposed to temperatures exceeding 300° C. in closed vessels, and consequently exposed to considerable pressure, is transformed into the amorphous condition in a few minutes. As during this conversion a notable elevation of temperature takes place, the pressure upon the sides of the apparatus must be very great. Hittorf is of opinion that manufacturers engaged with the preparation of amorphous phosphorus will welcome such an abridgment of the process. The question, however, arises whether, in the treatment of large quantities, difficulties, and even dangers, might not arise far outweighing the economy of time. According to the present method, when the conversion is effected in open iron vessels in which the air finds but limited access, the process is more tedious, but free from all difficulty.

Manufacture of Phosphorus.—The bulk of the phosphorus is still prepared in the manner indicated by Nicolas and Pelletier. From the bone-earth $Ca_3(PO_4)_2$ is obtained the primary phosphate, $CaH_4(PO_4)_2$, by treatment with sulphuric acid. This is converted by heat into calcium metaphosphate, $[Ca(PO_3)_2]$, and is then mixed with charcoal powder and distilled at a strong red heat.[*] Stoneware tubes are preferable to the retorts formerly in use, and care must be taken to allow the gases to escape unhindered so that there is no pressure to overcome. The importance of this in all cases where it is requisite to catch and condense vapours escaping from ignited earthen apparatus, will appear from the fact that not a trace of carbon bisulphide can be collected if its vapour has to overcome even a very slight pressure in earthenware apparatus.

The purification of crude phosphorus from impurities present in mechanical admixture, such as charcoal, &c., is best effected by forcing it at a slight pressure through leather by means of a Real's press, kept hot.

The residue (re-generated calcium tri-phosphate) is an excellent clarifying agent, especially for glycerin, and is in great request for this purpose.

The conversion of ordinary phosphorus into the amorphous condition is effected in iron boilers heated to 240°, and left open, but so that the air finds scanty admission through a narrow and rather long tube. The danger of explosion is thus obviated and very little phosphorus is burned, since the interchange of air in the boiler takes place very slowly, whilst the phosphorus consumes all oxygen so rapidly that within the boiler scarcely a trace of this gas is present. The amorphous phosphorus thus obtained, and still always retaining some of the ordinary modification, is ground under water, boiled with soda-lye to remove octahehral phosphorus, washed, and dried.

(To be continued.)

[1] Hittorf, *Pogg. Ann.*, cxxvi., 193.

[*] For further particulars see article "Phosphorus," by A. W. Hofmann in the already quoted "Report of the Jury on the London Exhibition of 1862."

CHROMIUM CRUCIBLE CAST-STEEL.

By SERGIUS KERN, St. Petersburg.

Most of the crucible steel is at present prepared by melting in fire-clay crucibles suitable mixtures of puddled steel, iron, steel or iron filings, with the addition of iron magnetic oxide as a flux and ferromanganese in order to reduce the oxides of iron resulting from the oxidation of the melted metal. When hard steel, the so-called instrumental steel, is desired, the iron or iron filings are replaced by refined cast-iron in the above-mentioned mixtures. The bars of puddled steel before being cut into pieces (1 inch by 1 inch) are ordinarily classified by their degree of hardness; this is done by breaking them by means of a hammer. But as the puddled bars are never uniform in respect of the percentage of carbon, the production of a required percentage of carbon in cast-steels is a rather difficult task. The following tables show to some extent the fluctuation of the percentage of puddled steels obtained by the ordinary way and by rolling the puddling blooms

into bars. The combined carbon was determined by the Eggertz colorimetric method. The normal steels were tested by the oxidation of the carbon of steels by chromic acid, and next collecting the resulting carbonic acid in a potash apparatus. It must be mentioned that puddled steel for the preparation of crucible cast-steel is always puddled with wood previously dried in suitable furnaces in order to avoid the use of coal, containing more or less sulphur. The use of such fuel certainly increases the price of the steel blooms.

TABLES OF ANALYSES OF STEEL BARS.

Sets of Hard Steel Bars.

Bar	Carbon. I.	Carbon. II.
A	0·77	0·58
B	0·77	0·58
C	0·51	0·31
D	0·58	0·31
E	0·58	0·31
F	0·79	0·31
G	0·51	0·58
H	0·79	0·51
I	0·51	0·51
J	0·51	0·58
Mean		
	near to 0·63	0·46

Sets of Soft Steel Bars.

Bar	Carbon. I.	Carbon. II.
A	0·18	0·18
B	0·18	0·22
C	0·22	0·18
D	0·22	0·18
E	0·47	0·18
F	0·27	0·18
G	0·47	0·27
H	0·18	0·18
I	0·47	0·18
J	0·22	0·22
Mean		
	near to 0·29	0·20

These analyses are only a few representatives of analyses of such kinds of bars in my hands; they clearly show why the metallurgist is always blind in mixing raw materials for the preparation of cast crucible steel. The use of Bessemer or Siemens-Martin steels avoids this difficulty very well; these steels are far cheaper than puddled steel.

The following experiments were made in order to prepare solid steel without blow-holes by the crucible process, which would give a good resistance and a proper elongation. The use of the rather dear ferromanganese was avoided, and the only substitutes of it in the new process are ground chrome ironstone ($FeOCr_2O_3$) and limestone previously calcined.

The annexed tables A and B show the composition of raw materials and receipts for the preparation of chromo-steel for various purposes. This steel is especially suitable for steel-casting direct in earth-moulds.

A. ANALYSES OF RAW MATERIALS FOR CASTING STEEL.

(*a.*) *Bessemer Rolled Steel Bars.*

	I. Per cent.	II. Per cent.
Combined carbon	0·100	0·250
Silicon	0·006	0·010
Manganese	0·020	0·030
Sulphur	traces	0·005
Phosphorus	0·010	traces
Copper	none	none

(*b.*) *Siemens-Martin Rolled Steel Bars.*

	III. Per cent.	IV. Per cent.
Combined carbon	0·400	0·600
Silicon	0·020	0·020
Manganese	0·030	0·130
Sulphur	0·010	none
Phosphorus	traces	0·001
Copper	traces	none

(*c.*) *Iron.*

	Per cent.
Combined carbon	0·12
Graphite	traces
Silicon	0·02
Manganese	traces
Sulphur	none
Phosphorus	none

(*d.*) *Refined Cast-Iron.*

	Per cent.
Combined carbon	4·25
Graphite	0·10
Silicon	0·03
Manganese	0·01
Sulphur	none
Phosphorus	none

(*e.*) *Chrome Ironstone.*

	Per cent.
Chromium oxide	65·51
Ferrous oxide (FeO)	31·65
Sulphur	none
Foreign matter	2·60
Copper	none

(*f.*) *Lime Calcined.*

	Per cent.
Calcium oxide	90·750
Silica	1·500
Iron oxide	2·750
Sulphur	0·010
Phosphorus	0·005

The chrome ironstone and limestone are calcined and next ground. The raw metallic materials are used for preparing the steel in the form of pieces of a square form (1 inch by 1 inch). Raw products having closely the above-mentioned composition may be used for the further receipts for the preparation of cast-steels.

B. RECEIPTS FOR THE PREPARATION OF CAST-STEEL.

	I. Kilogrms.	II. Kilogrms.
Bessemer steel, No. I.	24·00	10·00
,, ,, No. II.	5·00	22·00
Iron	5·00	2·00
Chrome ironstone	0·75	0·65
Limestone	0·25	0·35

The percentage of carbon in the received steels is about 0·20 to 0·25 in steel in No. I., and 0·45 to 0·55 in steel in No. II.

	III. Kilogrms.	IV. Kilogrms.
Martin steel, No. III.	20·50	2·00
,, ,, No. IV.	4·50	19·00
Refined cast-iron	8·75	12·00
Chrome ironstone	0·75	1·25
Limestone	0·50	0·75

The percentage of carbon in the received steels is 0·80 to 0·90 in steel No. III., and 1·0 to 1·3 in steel No. IV.

The mixture for steel-preparing is placed into previously heated fireclay crucibles; the chrome ironstone and the lime are placed on the bottom of the crucible, and next it is filled with the other materials, entering into the composition of the receipt. Ordinary coke-crucible or Siemens gas crucible furnaces are used for the operation.

The resulting four numbers of steel are quite sufficient for nearly all purposes as following:—

Steel No. I., for steel plates, rifle barrels.
,, No. II., for machinery parts, cannons, tyres, axles.
,, No. III., for instruments, cannon rings, saws.
,, No. IV., for chisels, planing tools, &c.

The annexed table shows the mean result of the mechanical tests of the above-mentioned steels. The steel ingots obtained were hammered to test bars, which after forging were cooled in water. From every number of the cast-steels mentioned in the tables six different specimens were examined.

Cast Steel. No.	Percentage of Carbon.	Tons per Square Inch. Began to Stretch.	Tons per Square Inch. Breaking Weight.	Elongation in Inches.
1.	0·25	25·3	48·1	1·35
2.	0·49	26·1	49·2	1·24
3.	0·95	24·8	52·3	1·13
4.	1·20	27·1	54·7	0·62

The samples of steels contain 0·08 to 0·25 per cent of chromium; as ordinary, hard steels contained more chromium than the soft specimens.

In preparing steel by this process the use of manganese alloys is avoided, which, in many cases, while reducing the iron oxides, give steel containing phosphorus and sulphur, as these elements are found in ferromanganese very frequently. By the new process cast-steel of a very good quality may be had at very moderate price, as the Bessemer and Martin steels are at present cheap and carefully prepared.

Obeuchon Steel Works.

ON THE ACTION OF VARIOUS FATTY OILS UPON COPPER.*

By WILLIAM HENRY WATSON, F.C.S.

At the last meeting of this Association some interesting experiments were brought before you on this subject by Mr. W. Thomson. His experiments were confined chiefly to the determination of the extent of the action of various oils upon metallic copper, from the appearances of the oils and surface of the copper-plates after long exposures, and from the comparative acidity of the various samples.

Having made some experiments in which I noted the appearances after exposures, and *determined* the *amount* of copper dissolved by the different oils used, I am able to speak of the rapidity with which some of them act, and now venture to bring the results before you.

The experiments were conducted as follows:—Into separate beakers 500 water-grain measures of each oil was poured, namely,—

1. Linseed oil.
2. Olive oil.
3. Almond oil.
4. Colza oil.
5. Seal oil.
6. Sperm oil.
7. Castor oil.
8. Neatsfoot oil.
9. Sesame oil.
10. Paraffin oil.

The above numbers will be mentioned farther on instead of mentioning in each case the name of the oil.

Into each of these samples of oil a piece of copper-foil exposing 8 square inches of surface was immersed. The beakers were then placed in a room above the Laboratory and covered by pieces of porous paper. The appearances were noted occasionally as follows, from which it will be seen that several of the oils acted somewhat rapidly upon the copper:—

(*a.*) Examination after two days' exposure:—

1. The oil is slightly green near the copper. The copper is not changed in appearance.
2. The oil immediately surrounding the copper is of a slight green colour, and the copper is a little tarnished.
3. No change in the appearance of either the oil or the copper.
4. This oil is considerably more green than in oils 1 and 2. The copper is a little tarnished, not quite so much as that in No. 2.
5. The colour of this oil is now a light green. The appearance of the copper is not changed.
6. There is no apparent change in the colour of either the oil or the copper.
7. Ditto, ditto.
8. A little greenness in the oil. The copper has slight irregular brown markings on its surface, evidently on the impressions left by passing through the rollers.
9. The oil is slightly tinged a greenish yellow.
10. No change in either the oil or the copper.

Thus, with the exception of Nos. 3, 6, 7, and 10, all the samples had acted to some extent (from appearance) upon the copper by being exposed two days.

(*b.*) Examination after five days' exposure:—

1. The appearance of this oil is similar to that when last observed, but the copper has a flocculent green deposit on some portions of it which were not then present.
2. This oil is more green than when last noted, while the copper is coated with a green deposit (a thin green skin) which is easily removed by agitating the oil.
3. This oil is of a very slight green colour. The appearance of the copper is not changed.
4. This oil is considerably green in colour. The copper remains as before.
5. The green colour or this oil is rather deeper than when last observed.
6. This oil is not changed in appearance. The copper is also as when first immersed.
7. There is a slight greenness in the oil immediately surrounding the copper. The appearance of the copper is not changed.
8. The appearance of this oil and copper is the same as when last observed.
9. The oil is slightly tinged a greenish yellow, about as when last observed. The copper remains as when first immersed.
10. No change noticeable.

Thus, by five days' exposure, all the oils had acted upon the copper with the exception of Nos. 6 and 10 (sperm oil and paraffin oil).

(*c.*) Examination after ten days' exposure:—

1. The appearance of this oil and copper is as when last examined.
2. This oil appears about the same, with regard to colour, as when last noticed, but there is considerably more of the green deposit on the surface of the copper.
3. This oil is of a rather deeper green colour than when last examined, and the copper is slightly tarnished.
4. This oil is considerably green. The copper is a little tarnished.
5. The colour of this oil is a rather deeper green than when last noticed. No apparent change in the copper.
6. No greenness in the oil, but the copper is slightly tarnished.
7. This oil is tinged very slightly green. The copper remains as before.
8. This oil is considerably green, and the copper has become a litttle tarnished.
9. This oil is green, but not quite so green as No. 8. The copper remains bright.
10. No apparent change.

Here it is seen that, with the exception of No. 10 (the paraffin oil), the appearance of each oil indicated more or less action upon the copper during the ten days' exposure. After the above observations the various samples were examined quantitatively for copper. The method adopted may be described as follows:—The copper-foil is removed from the beaker, and as much of the oil allowed to drain from it as possible. Any deposit on the copper and any oil remaining is removed by cotton-wool. The oil is treated with hot water to which a few drops of nitric acid had been added, and violently shaken. On being allowed to stand, the solution separated from the oil is drawn off. This washing operation is repeated several times with pure water, and the whole of the washings collected. The cotton-wool used in removing the oil and any deposit from the surface of the copper is ignited, and the ash treated with a drop of nitric acid; this is then washed into the previous washings, and the whole, by addition of

* Read before the British Association, Plymouth Meeting, Sec. B.

water, made to measure 4000 grains. This solution contains the whole of the copper dissolved by the oil under examination. A portion of it (generally 100 measures) is taken and diluted to 1000, a few drops of ammonium sulphide solution added, and the depth of colour produced compared with that produced similarly in a solution of copper of known strength. In the case of 100 measures of the washings being used the results are multiplied by 40, thus furnishing the total amount of copper present.

By such examination the amount of copper found in each of the samples of oil after ten days' exposure was as follows :—

1. Linseed oil	.. ..	0·3000 grain.
2. Olive oil	.. ..	0·2200 ,,
3. Colza oil	.. ..	0·0170 ,,
4. Almond oil	.. ..	0·1030 ,,
5. Seal oil	.. ..	0·0485 ,,
6. Sperm oil	.. ..	0·0030 ,,
7. Castor oil	.. ..	0·0065 ,,
8. Neatsfoot oil (English)	.. ..	0·1100 ,,
9. Sesame oil	.. ..	0·1700 ,,
10. Paraffin oil	.. ..	0·0015 ,,

The conclusions afforded by these quantitative results are not such as I should have drawn from the appearances of the various samples as previously noted; for while Nos. 4 and 8 were very much more green than any of the other samples, yet the amount of copper was larger in Nos. 1, 2, and 9. From this it would appear that some of the oils form a compound with copper having a deeper green colour than others, and that there may be, therefore, a greater depth of colour with a less amount of copper in one oil than in another. It follows, then, that we cannot satisfactorily conclude as to the action of different oils upon copper merely from the appearance of them after being in contact with it for some time. The considerable colour which very small quantities of copper produce in some oils (and especially in almond oil) is remarkable: there is therefore no difficulty in detecting the *presence* of copper, though to arrive correctly at the comparative quantity in different oils seems to be impossible, from mere observance of the appearances of the samples.

I commenced some fresh experiments with the view of exposing the samples for a much longer period, under the same conditions as the former ones. They were examined after seventy-seven days of exposure, but accidentally the sample of neatsfoot oil and the sample of sesame oil were damaged during the exposure. I am therefore only able to speak of the remaining eight samples, as follows :—

Copper found in the Oil after Seventy-seven Days' Exposure.

1. *Linseed Oil.*—This oil is very green. The green compound appears to be chiefly in solution. The copper is a little tarnished. 0·5435 of a grain.

2. *Olive Oil.*—This oil is very green; more blue than that in sample No. 1, and chiefly in suspension. This flocculent compound, which covers the copper, is easily removed, and when removed the surface of the metal is quite bright. 0·2400 of a grain.

3. *Colza Oil.*—This oil is of a yellowish green colour. A light transparent skin, of a green colour, has become attached to the copper. 0·1400 of a grain.

4. *Almond Oil.*—This oil is very green. It is a blue-green, and suspended in the oil: there is a flocculent compound of a similar colour. The surface of the foil is quite bright. 0·2200 of a grain.

5. *Seal Oil.*—Very green; not so blue a green as that in the almond oil. The copper is irregularly tarnished. 0·0800 of a grain.

6. *Sperm Oil.*—This oil is only very slightly green. The copper has a thin green skin attached to its surface. 0·0600 of a grain.

7. *Castor Oil.*—A very slight greenness in the oil. The copper is quite bright. 0·0100 of a grain.

8. *Paraffin Oil.*—No apparent greenness in the oil. The copper is quite bright. 0·0030 of a grain.

By deducting the amounts of copper found in the different samples exposed ten days from the amounts found in those exposed seventy-seven days, we arrive at the quantities dissolved between the two dates, thus :—

1. Linseed oil	.. ..	0·2435 grain.
2. Olive oil	.. ..	0·0200 ,,
3. Colza oil	.. ..	0·1230 ,,
4. Almond oil	.. ..	0·1170 ,,
5. Seal oil	.. ..	0·0315 ,,
6. Sperm oil	.. ..	0·0575 ,,
7. Castor oil	.. ..	0·0035 ,,
8. Paraffin oil	.. ..	0·0015 ,,

The action of the olive oil was greatest at its first exposure, for during the first ten days it had dissolved 0·22 of a grain, while in the following sixty-seven days it only dissolved 0·02 of a grain of copper, according to the experiments in the first and second series.

In conclusion, the results of my experiments show that, of the oils examined, paraffin oil and castor oil, when pure, have the least action upon copper, while the action of sperm oil and seal oil is but slight. The rest of the oils taken all act considerably, and the action of linseed oil is especially great.

Braystones, near Whitehaven,
July, 1877.

IODIDES AND IODATES.

By WILLIAM STEVENSON.

The following process is recommended for making iodic acid, hydriodic acid, and most iodides and iodates :—

Dissolve 2 parts of baric hydrate in 4 parts of boiling water; add gradually 3 parts of iodine, and filter when the solution is neutral and colourless. The reaction is as follows :—

$$6BaH_2O_2 + 12I = Ba_2IO_3 + 5BaI_2.$$

The precipitated iodate of baryta may be used for iodic acid by decomposing with sulphuric acid, filtering, and evaporating the filtrate to crystallisation *in vacuo*. By substituting an equivalent of any soluble sulphate the iodate may be readily formed, thus :—

$$Ba_2IO_3 + (NH_4)_2SO_4 = BaSO_4 + 2NH_4IO_3.$$

The same applies to the filtrate containing the iodide of barium, which may be employed for hydriodic acid by adding sulphuric acid till no further precipitate occurs; or by decomposing with any soluble sulphate the corresponding iodide may be made :—

$$BaI_2 + MgSO_4 = BaSO_4 + MgI_2.$$

TRADE IN DIPLOMAS.

We extract the following from the *Chemiker Zeitung* :—

"An advertisement in a German paper announces that doctors' diplomas of a highly respected university, which has hitherto not granted degrees *in absentia*, as well as orders and titles of different states, including the papacy, letters of nobility, &c., can be procured for suitable persons genuine and direct, and without prepayment, by Dr. ———, Ravensdon Street, London, S.E."

The editor of the *Chemiker Zeitung* wrote to this address inquiring how the doctors' diplomas, orders, and titles were to be obtained, what were the qualifications required, and what was the charge for each degree of distinction. He received a prospectus partly printed, partly written, to this effect :—

"London.

"Honoured Sir,

"In reply to your inquiry I beg to state that I am the sole representative of a new English university, and that

the conditions of graduation are as follows:—Degrees are given in all the faculties, in philosophie, medicine, law, theology, dentistry, chemistry, &c., and under certain circumstances in music. Every candidate must send in an accurate sketch of his life, a literally true account of his studies, certified by his word of honour, or testimonials of examinations which he has passed, and, where these are insufficient, a good dissertation founded upon original research. Gentlemen who have not the advantage of a university career, but whose position in life is such that a scientific qualification may be inferred, or who have acquired a general culture by private study, can receive the degree of Dr. Philos. on sending in an account of their life and a satisfactory dissertation.

"After a brief statement of his course of culture every candidate will be at once informed what qualifications will be demanded for the attainment of the degree of doctor. The graduation fees, &c., amount to 650 marks (£32 10s.). The university reserves the right of demanding original testimonials, which, however, will be returned to the candidate. The degree of doctor is by no means purchasable.

"For candidates who cannot graduate at this university, I can on merely sending in a sketch of life procure the degree of doctor in all faculties from the American University of Philadelphia, or the Livingstone University, for the total charge of £25.

"Only a single German university now grants degrees *in absentia*, and that only to candidates who have passed a "state examination," and only in the faculties of philosophy and law. Degrees *in presentia* are granted to those only who can prove that they have studied for six terms at a university. I am prepared to give every assistance to such candidates.

"I must particularly call your attention to the fact that those diplomas only are genuine which bear the seal and signature of the commissioner here resident.

"As to the orders, titles of nobility, it is not my custom to state particulars to anonymous inquirers, as these are most delicate and confidential affairs, but I may tell you that I can offer you general- and vice-consulates' gold and silver medals for merit in art or science, &c., for fees ranging from £12 10s. to £1250, and from different countries."

We certainly feel curious to know the name of the newly-founded English university which grants degrees *in absentia* through a sole agency in the S.E. postal district.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 16, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

MR. MACKERETH, F.R.A.S., stated that he had observed an unusual disturbance of his magnetometer at Eccles on the day preceding the great storm of the 15th, and that similar disturbances often occurred immediately before or during great and violent atmospheric changes.

Mr. M. M. PATTISON MUIR, F.R.S.E., exhibited and gave a description of a modified form of Hofmann's apparatus for determining vapour densities.

"*Note on an Edible Clay from New Zealand*," by M. M. PATTISON MUIR, F.R.S.E.

I lately received from my friend Mr. R. E. Day, M.A., a small specimen of a clay which is greedily eaten by the sheep in a certain district in New Zealand.

The clay was brought by Mr. Day from Simon's Pass Station, Mackenzie country, South Island. It there forms a range of low bare hills: the sheep (merino sheep) eat very considerable quantities of the clay without appearing to be any the worse for it. So far as Mr. Day could learn, the clay-eating is confined to this particular part of the islands. It is supposed by the shepherds that the clay must contain salt, and that it is to supply the deficiency of this article of food that the sheep resort to the earth. The analysis shows that very probably the shepherds are right, although one would suppose that to consume so much silica and alumina for the sake of the small proportion of salt was hardly an economical proceeding on the part of the sheep.

The alkali was determined by Lawrence Smith's process of fusion with calcium carbonate and ammonium chloride. The water was determined by heating in a stream of dry air, and direct weighing of the moisture expelled; the organic matter, by noting the difference between the amount of water thus obtained and the total loss suffered on ignition.

Silica	61·25
Alumina	17·97
Ferric oxide	5·72
Calcium ditto	1·91
Magnesium ditto	0·87
Alkalies* (as chlorides)	3·69
Organic matter	1·77
Water	7·31
	100·49

"*On the Decomposition of Calcium Sulphate by Alkaline Chlorides: a Contribution to Agricultural Chemistry*," by M. M. PATTISON MUIR, F.R.S.E.

In one of his papers upon Diffusion† Graham describes experiments which prove that a solution of potassium or sodium sulphate in lime-water, when allowed to diffuse into lime-water, yields a diffusate containing potassium or sodium hydrate; but that a solution of potassium or sodium chloride is not decomposed by lime-water under the same circumstances. Graham further shows that when solutions of calcium sulphate and potassium or sodium chloride are mixed, no decomposition ensues at the ordinary temperature, but that on boiling the mixed liquids for some time sulphate of sodium (or of potassium) is found, and continues to exist in the cold solution, inasmuch as if lime-water be added two or three days after the boiling has been carried out, and the mixture be allowed to diffuse into pure water, caustic soda or potash is found in the diffusate. Graham suggests that if solutions of calcium sulphate and sodium or potassium chloride be allowed to react one upon another for a considerable time, at ordinary temperatures, a decomposition might slowly take place analogous with that which is quickly produced when the mixed solutions are heated. If such a decomposition indeed take place, we shall have, says Graham, a reaction, which, occurring in the soil, may lead to the ultimate production of those alkaline carbonates required by plants for their nutrition. The steps in the process would be these:—Decomposition of the alkaline chloride by calcium sulphate, with production of alkaline sulphate; decomposition of the alkaline sulphate by lime, added to or originally present in the soil, with production of alkaline hydrate; transformation of the alkaline hydrate into carbonate by the action of carbonates in the soil, or of carbonic acid in the water and air.

The investigations of Graham and others have shown that the two last stages are readily accomplished.

2. In order to determine whether the first stage in the series of transformations is or is not attainable, I mixed solutions of calcium sulphate and sodium chloride, and allowed the liquids to remain at the ordinary temperature

* The alkali consisted almost entirely of soda. The clay contained small quantities of phosphoric acid.

† "On the Application of Liquid Diffusion to produce Decomposition."—*Journ. Chem. Soc.*, iii., 60.

f the air (15° to 18°) for several weeks. If decomposition had taken place the liquids would contain calcium sulphate, sodium chloride, calcium chloride, and sodium sulphate: the first of these salts is insoluble in ordinary alcohol; hence the addition of alcohol to the mixture would throw down the whole of the calcium sulphate existing as such, without otherwise influencing the state of equilibrium of the various salts in the liquid. In order to determine the amount of calcium sulphate which had undergone decomposition it was therefore only necessary to wash the precipitate produced by adding alcohol, with dilute spirit, and to ignite and weigh it.

The following are my results:—

(*a.*) 100 c.c. of $CaSO_4$ solution = 191·0 m.grms. $CaSO_4$ mixed with 10 c.c. of NaCl solution = 233·3 m.grms. NaCl.
Amount of $CaSO_4$ in solution after twenty-eight days = 167·0 m.grms.
Hence amount of Na_2SO_4 found = 25 m.grms.

(*b.*) 100 c.c. $CaSO_4$ solution mixed with 50 c.c. NaCl solution = 1166·5 m.grms. NaCl.
Amount of $CaSO_4$ in solution after twenty-eight days = 103·0 m.grms.
Hence amount of Na_2SO_4 produced = 93·9 m.grms.

(*c.*) 100 c.c. $CaSO_4$ solution mixed with 100 c.c. NaCl solution = 2333 m.grms. NaCl.
Amount of $CaSO_4$ in solution after twenty-eight days = 64·0 m.grms.
Hence amount of Na_2SO_4 produced = 132·7 m.grms.

3. It is very evident, then, that Graham's supposition is correct. Without the aid rendered by diffusion, time alone is sufficient to bring about a decomposition of calcium sulphate in solution by sodium chloride, also in solution. If this decomposition is then realised in the Laboratory, there can be little doubt that under the more favourable conditions offered by the soil the decomposition will play a somewhat important part in the nutrition of plant-life.

4. The numbers which I have obtained show that the extent of the decomposition under consideration is influenced not only by the time during which the salts are allowed to remain in contact, but also by the mass of sodium chloride employed. The amount of chemical action is almost directly proportional to the mass of the sodium chloride employed, the amount of calcium sulphate remaining constant.

"*On some Thionates*," by H. Baker, Student in the Owens College. Communicated by Professor C. Schorlemmer, F.R.S.

Having been lately working on these salts, I offer the following observations:—

Barium Dithionate, $BaS_2O_6 2Aq$.—According to Heeren* this salt is soluble in 1·1 parts of boiling water; but he does not give the boiling-point of the saturated solution: this I have observed to be 102°, and its solubility at this temperature to be 1 in 0·994 parts of water. It is remarkable that the saturated solution of such a soluble salt should boil at so low a temperature. The sp. gr. of the crystals of this salt at 13·5 is 4·536.

Lead Dithionate, $PbS_2O_6 4Aq$.—"Is very easily soluble in water" (Watts). I find its solubility at 20·5° to be 1 in 0·869 part of water. Its sp. gr. at 11° is 3·259.

Calcium Dithionate, $CaS_2O_6 4Aq$.—The crystals have a sp. gr. of 2·176 at 11°.

Nickel Dithionate, $NiS_2O_6 6Aq$.—One part of this salt dissolves in 0·897 part of water at 12°.

Magnesium Dithionate, $MgS_2O_6 6Aq$. — According to Watts's Dictionary "forms six-sided tables, very soluble in water;" but Gmelin says it forms ill-defined six-sided prisms. I obtained it in oblique prisms, and found its solubility at 17° to be 1 in 0·692 part of water.

Sodium Dithionate, $Na_2S_2O_6 2Aq$.—Its sp. gr. at 11° is 2·175. Watts says "it crystallises by spontaneous evaporation in large transparent right-rhombic prisms." Gmelin gives several measurements, but they are not sufficient to calculate all the forms from. My measurements show the crystals to be rhombic, and the axes to be—

$$\breve{a} : \breve{b} : c = 0{\cdot}9922 : 1{\cdot}0000 : 0{\cdot}5981 ;$$

the forms occurring are ∞P, $\breve{P}\infty$, P, $\breve{P}\frac{1}{2}$, $\infty P\infty$, and the type is long prismatic, through predominance of ∞P. In these and the following angular measurements the interfacial angles are denoted as in "Kopp's Krystallographie," viz.:—

A = the angle of a pyramid over a vertical edge in the brachy-diagonal.
B = the angle of a pyramid over a vertical edge in the macro-diagonal.
C = the angle of a pyramid over a lateral edge.
W = the acute angle in the vertical prism, and the lateral angle in a dome.

Form.	Angle.	Calculated.	Found.	Gmelin.
		° ′	° ′	° ′
P	A	125 45	125 40	125 48
	B	125 18	125 29	125 18
	C	81 11	—	80 18
$\breve{P}\frac{1}{2}$	A	88 39	88 34	—
	B	137 43	137 40	—
∞P	W	89 33	89 25	89 22 and 89° 36′
$\breve{P}\infty$	W	62 9	62 3	62 12

Silver Dithionate, $Ag_2S_2O_6 2Aq$, forms, according to Watts, right-rhombic prisms, isomorphous with sodium dithionate. Gmelin gives some measurements. I find the axes to be—

$$\breve{a} : \breve{b} : c = 0{\cdot}9884 : 1{\cdot}0 : 0{\cdot}5811,$$

and the forms $\breve{P}\infty$, P, ∞P, $\breve{P}\frac{1}{2}$, $\infty \breve{P}\infty$, $\infty \breve{P}\infty$; the type is very short prismatic.

Form.	Angle.	Calculated.	Found.	Gmelin.
		° ′	° ′	° ′
P	A	126 47	126 51	127 0
	B	126 6	125 55	126 0
	C	79 9	79 8	79 10
$\breve{P}\frac{1}{2}$	A	89 54	89 58	90 12
	C	104 58	104 52	—
∞P	W	89 20	89 22	89 8
$\breve{P}\infty$	W	60 54	61 1	—

Silver Sodium Dithionate, $(AgNa)_2S_2O_6 2Aq$, is, according to Watts, "apparently isomorphous with the component salts." I find it to be rhombic with the axes—

$$\breve{a} : \breve{b} : c = 0{\cdot}9813 : 1{\cdot}0000 : 0{\cdot}5856,$$

and the forms $\breve{P}\infty$, P, $\infty \breve{P}\infty$, ∞P, $\infty \breve{P}\infty$: the dome is developed so much as to make the crystals horizontally prismatic, the prism is only slightly developed, and the pyramid $\breve{P}\frac{1}{2}$ does not occur. Watts also says it "exhibits very distinct cleavage." This cleavage plane I find to be ∞P, and I also find that the sodium and the silver dithionates exhibit very distinctly this cleavage.

Form.	Angle.	Calculated.	Found.
		° ′	° ′
P	B	125 30	125 23
	C	79 48	79 46
∞P	W	88 55	89 1
$\breve{P}\infty$	W	61 39	61 41

This sample contains per cent Ag 32·0.
$AgNaS_2O_6 2Aq$ requires per cent Ag 33·0.

Potassium Trithionate, $K_2S_3O_6$.—The following are the statements regarding the crystalline form of this salt:—Gmelin gives two: (1) "Slender four-sided obliquely truncated prisms (Plessy, *J. für Prakt. Chem.*, 33, 348)," (2) "Right rhombic prisms, with dihedral summits resting on the acute lateral edges (Provostaye, *N. Ann. Chim. Phys.*, 3, 354)." According to Watts it forms four-sided

* *Pog. Ann.*, 7, 172.

prisms, bevelled with two faces; and according to Miller it crystallises in the rhombic system, prismatic type with dihedral summits. I obtained it in rhombic needles of ∞P, with the acute edges modified by another prism, $\infty \breve{P}2$; $\infty \bar{P}\infty$ and $\infty \breve{P}\infty$ are also present; they are terminated by a brachy-dome. Some of the crystals taper like a sewing-needle—I suppose through the presence of a very acute pyramid. I find the axes to be—

$$\breve{a} : \bar{b} : c \quad 0{\cdot}3536 : 1{\cdot}0000 : 0{\cdot}4204,$$

and the observed forms are ∞P, $\infty \bar{P}2$, $\infty \bar{P}\infty$, $\infty \breve{P}\infty$, $\bar{P}\infty$.

Form.	Angle.	Found.	Calculated.
∞P	W	39 31	39 28
$\infty \bar{P}2$	W	71 12	71 18
$\bar{P}\infty$	W	45 37	45 37

This salt is prepared by acting on a saturated solution of potassium thiosulphate with SO_2. Now, as it is not stated that sodium thiosulphate will not similarly yield sodium trithionate, nor any reason given why it should not, I attempted to prepare sodium trithionate in this manner, but only obtained crystals of sodium thiosulphate. Rathke (*Journ. pr. Chem.*, 95, 13) prepares sodium trithionate as a white powder by decomposing potassium trithionate with sodium tartrate.

CORRESPONDENCE.

SPECIFIC GRAVITY APPARATUS.

To the Editor of the Chemical News.

SIR,—The apparatus described by Mr. J. Taylor (CHEM. NEWS, vol. xxxvi., p. 168) is somewhat older than your correspondent P. H. makes out, and has a little history of its own. It appears to have been discovered by Dr. Hare, the American chemist and physicist, and described in *Silliman's American Journal* (vol. xi., for 1826). I have not been able to see this Journal, but in the *Quarterly Journal of Science and Arts* (vol. xxi., p. 384, 1826) a description of it is quoted from *Franklin's Journal*. Sir James Murray re-invented it in 1843 (*Mechanics' Magazine*, January 13th, 1844), and Mr. Ham again invented it in 1844 (*Chem. Gaz.*, ii., p. 125). As a specific gravity apparatus it has little worth, but perhaps Dr. Hare's original one is the best in detail, as described in par. 407 of Bird and Brookes (5th ed., 1860).—I am, &c.,

C. O'N.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 16, October 15, 1877.

Non-Transparence of Incandescent Iron and Platinum.—G. Govi.—In a paper in the *Comptes Rendus* of 1867 (lxiv., p. 778) is found an account of a series of experiments, according to which iron, even of the thickness of 5 m.m., became transparent if heated almost to whiteness. The author seeks to connect this transparence of ignited iron with the phenomena of dialysis, which take place through strongly heated metals. M. Govi does not see any connection between the phenomena of osmose and the transparence of substances, and finds experimentally that iron and platinum, even in thin layers and heated to whiteness, are impervious to light.

Use of Lime-Water to Fix the Fatty Acids in Water used to Feed Steam Boilers. M. Hétet. The author states that oil introduced into steam for the lubrication of the cylinders, &c., are there decomposed into fatty acids and glycerin. Being carried along to the condenser these products of decomposition finally reach the boilers, where they accumulate, and the water of the boilers soon becomes an emulsion of fatty acids. These acids soon attack the boiler-plates, forming enormous black deposits, mixtures of iron soaps, and oxide of iron in variable proportions, which adhere to the surface of the metal and form dangerous incrustations. To obviate these evils the author treats the feed-water before it enters the boilers with lime-water, so as to render it neutral or slightly alkaline.

Formation of Allylen at the Expense of Bromocitra-pyro-tartaric Anhydride.—E. Bourgoin.—If the anhydride above mentioned is dissolved in water and the solution neutralised with ammonia, nitrate of silver gives a precipitate, which disappears on ebullition, but which becomes permanent and very copious under the influence of an excess of the reagent. This salt if suspended in water is easily decomposed and blackens on ebullition. On heating it for some hours to 130° in a sealed tube a large quantity of gas escaped when the tube was opened, which proved to be a mixture of allylen and carbonic acid.

On Dibromethyl-carbylamin.—M. Tcherniak.—This compound may be regarded as cyanate of ethyl, the oxygen in which has been replaced by bromine.

Researches on Vegetable Gluco-genesis.—V. Jodin.—Most, if not all, of the higher vegetables contain saccharine matter diffused in their organs. This saccharine matter is generally a mixture of saccharose and of inverted sugar. The amount of sugar is generally smallest in the leaves, and reaches its maximum in the flowers, fruits, stems, and roots, which possess the chlorophyllic function transitorily or but in a slight degree. The slight proportion of sugar in the leaves is, however, no direct proof against the production of sugar by these organs. On the other hand, the constant presence of sugars in all the fungi appears to prove manifestly the mutual independence of the glycogenic and of the chlorophyllian functions. These two functions are found in juxtaposition in the green leaf without the existence of any relation of immediate causality between them.

Detection of Fatty Matters Fraudulently Introduced into Butter.—C. Husson.—Natural butter is known to be of good quality by treating a given weight with 10 parts of a mixture of equal volumes of ether at 66° and of alcohol at 90°. The solution is effected by placing the mixture in the water-bath at the temperature of 35° to 40°, and then letting it cool down to 18°. After twenty-four hours genuine butter should leave a deposit of pure margarin, which must not exceed 40 per cent nor fall below 35. An increase in this figure proves sophistication by means of tallow, whilst a decrease shows the presence of "margarin Mouries," of lard, or of goose-grease.

No. 17, October 22, 1877.

Modifications effected in the Conditions of the Maxima of Electro-magnets by the more or less Complete State of Magnetic Saturation of their Magnetic Nucleus.—M. Th. du Moncel.—Not suitable for abstraction.

Experiments relative to the Formation of Ultramarine.—M. J. F. Plicque.—The majority of the hypotheses which have been framed concerning the chemical constitution of ultramarine are based upon analyses executed with products obtained industrially. The centesimal composition of the substances reacting is always rigorously determined, but as during this manufacture a part only of the components serves to produce

ultramarine, whilst the remainder yields soluble products, ultimately eliminated by washing; as, further, the proportions of silica and alumina may vary in the mixtures without the blue colour being sensibly affected, the analytical results are so complex that it is difficult to deduce from them a rational formula. The author has sought to realise the synthesis of ultramarine by a laboratory method which would enable him to employ chemically pure silica, alumina, soda, and sulphur in the formation of the blue colour. On examining in what proportion the silica, alumina, and soda should combine, he observed that the insoluble alumino-silicate of soda obtained by Deville presents the same proportions of silica and alumina as the mixtures employed in certain establishments for the production of blue ultramarine. This silico-aluminate of soda contains 44·6 of silica, 26·4 of alumina, 16·3 of soda, and 12·7 of water. The ratios of oxygen are as 6, 3, 1, 3. On heating it for thirty hours in a muffle with 25 per cent of sulphur and 2 per cent of resin, an ultramarine of a perfect shade is obtained. In order to examine the different reactions produced, the author operated in the following manner:—Silicate of soda prepared with pure materials, and aluminate of soda likewise pure, were mixed in equivalent solutions. The product obtained on collecting the precipitate upon a filter, and drying rapidly at 110°, always contained an excess of soda, and presented the following composition:—

Silica	31·105	31·150
Alumina	18·402	18·410
Soda	29·367	29·359
Water	20·750	20·749
	99·624	99·688

The material employed in these experiments contained therefore 60·86 per cent of the silico-aluminate of soda, in which the ratios of oxygen are 6.3.1. Upon this molecule ($3SiO_2Al_2O_3NaO$) he caused to react sulphuretted hydrogen and sulphurous acid at the temperature of dull redness, about 750°. He also used sulphide of carbon in place of sulphuretted hydrogen, and by operating for several days he hoped to obtain the crystalline ultramarine of MM. G. Grünzweig and R. Hoffmann. 100 parts of silico-aluminate of soda heated for ninety hours in the vapour of carbon bisulphide yielded 96·840 of a sulphuretted product, white, slightly yellowish, which on exposure to moist air absorbs oxygen with rapidity and becomes bluish, sulphuretted hydrogen being developed at the same time. This 96·840, heated for ten hours in sulphurous acid until the weight became constant, gave 107·6 of ultramarine-blue, the sulphurous acid being absorbed in very large quantity; and during this second stage of the operation a large proportion of sulphur was evolved and deposited in the colder parts of the porcelain tube. The blue thus produced at the temperature of about 750° contains no free sulphur, but 41·3 sulphate of soda, which can be eliminated by washing with boiling water. No soluble sodium sulphide could be detected. This ultramarine, when carefully washed with distilled water, was of a very deep and pure blue, but did not present the violet tone of the ultramarines of commerce. Its composition was found to be as follows:—

Silica	46·810	$3SiO_3$
Alumina	27·702	Al_2O_3
Soda	17·280	NaO
Sulphur	5·217	
Oxygen	2·991	cal. as loss.
	100·000	

On examining these figures we see that the silica, alumina, and soda found in the blue are still in the same proportions as in the insoluble silico-aluminate of soda. The excess of soda contained in the precipitate employed has been entirely converted into sulphate of soda. The author not having succeeded in obtaining crystallised ultramarine, has not been able to assign a formula to this compound, but he infers from his experiments that:—Contrary to the assertions of certain German authors, ultramarine contains no nitrogen. Blue ultramarine, properly so-called, is formed by an oxy-compound of sulphur, which is probably fixed both upon the sodium and the aluminium. During the first period of the operations, the passage of the sulphide of carbon, the sulphur is substituted for a part of the oxygen in the molecule of the silico-aluminate of soda, and in the excess of soda it completely replaces oxygen. The sulphurous acid, reacting upon this first compound, takes the place of a part of the sulphur of the molecule of the sulphuretted silico-aluminate of sodium, and destroying the sodium sulphide not chemically combined with silica and alumina, converts it into sulphate of soda. To obtain these results it is necessary to keep the materials for several days in the vapour of carbon bisulphide at 750°. If the temperature is raised to 1000° we obtain a black agglomerated product, which on treatment with water evolves sulphuretted hydrogen, and is transformed into ultramarine-blue. This product evidently contains Fremy's aluminium sulphide, and this experiment renders it conceivable that a part of the sulphur in ultramarine may be found in the state of aluminium oxy-sulphide. If instead of sulphuretted hydrogen and sulphurous acid we use seleniuretted hydrogen and selenious acid, a red compound is produced analogous to the blue, whilst tellurium similarly applied gives a yellow product.

Catechins and their Constitution.—M. Arm. Gautier.—Not adapted for abstraction.

Acid Acetates.—M. A. Villiers.—The existence of acid acetates, or at least of anhydrous acid acetates, might be foreseen from the study of the tensions of dissociations. In fact, neutral acetates placed in contact with the vapour of acetic acid behave in the same manner as salts capable of forming hydrates when brought in contact with watery vapour.

Researches on Butylen and its Derivatives.—M. E. Puchot.—Butylen is soluble in 10 parts by weight of water; acetic acid (monohydrated) dissolves 62 times its own volume. The specific gravity of butylen in the gaseous state is approximately equal to 2°. Butylen is a liquefiable gas. The liquid boils at −4°; its specific gravity at $-13°5 = 0·635$.

Revue Universelle des Mines, de la Metallurgie, &c., July and August, 1877.

Present Condition of the Zinc and Copper Industries of the United States.—J. Beco.—There are two zinc-mining districts in America, that of the east comprising Pennsylvania, New Jersey, New York, and Virginia, and that of the west between the Alleghanies and the Rocky Mountains. The first discoveries of zinc ore were made as early as the seventeenth century, but it was generally supposed to be an immature lead ore which would be developed in course of time. In 1850 the New Jersey Zinc Company succeeded in obtaining both metallic zinc and zinc-white from the red oxide found in the County of Sussex. The author remarks that hitherto no decisive progress has been effected in the manufacture of pure zinc in the United States.

Les Mondes, Revue Hebdomadaire des Sciences, No. 6, Oct. 11, 1877.

The "hygroscopic flowers," which change their colour according to the degree of moisture in the atmosphere, and which are supposed to be a modern invention, were suggested by Herbelot in 1737, and were made on a commercial scale in 1792.

No. 7, October 18, 1877.

This issue contains no chemical matter except an account of the scientific labours of the late Prof. Graham.

MISCELLANEOUS.

Appointment of Public Analyst.—William Arnot, F.C.S., Analytical Chemist, Edinburgh, has just been appointed Public Analyst for the Counties of Roxburgh and Selkirk, and the Burghs of Hawick, Galashiels, Selkirk, and Kelso. We observe that Mr. Arnot is to deliver a Course of Cantor Lectures on Paper, at the Society of Arts, during the forthcoming Session.

Columbium.—We shall soon hear of columbium-plating, a metal which is very much like nickel, but whiter, like tin. It was first found, more than fifty years ago, in the United States, near Middletown, Conn., and named in honour of America. It was thus far very scarce, but has now been found at Marion, N.C., and also in the Amazon stone of Colorado. If it becomes abundant enough to be used in the arts we may soon have a valuable addition to the useful metals, and also to their compounds or salts. The metal forms an acid like tin, called columbic acid; tin forms stannic acid, and the compounds of this acid with bases are stannates, very useful in the arts; the compounds of columbic acid with bases must be called columbates. They have not yet been investigated, but will likely be found extremely useful for some purposes.—*Manufacturer and Builder*, ix., 183.

NOTES AND QUERIES.

Portland Cement.—Can any correspondent inform me of any work where I can find full information on the manufacture of Portland cement?—A. P.

MEETINGS FOR THE WEEK.

SATURDAY, Nov. 3rd.—Physical, 3.
MONDAY, 5th.—Royal Institution, 2. (General Monthly Meeting).

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THE CHEMICAL NEWS.

VOL. XXXVI. No. 937.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 198.)

Phosphorus and Matches. By Dr. ANTON VON SCHRÖTTER, Master of the Imperial Mint at Vienna.

For the preparation of phosphorus bone-earth, as already mentioned, is generally employed. It is, however, stated that latterly phosphorites have come into use for this purpose in England, a step which will be ultimately necessitated by the increasing demand for phosphorus, and by the other applications of bones. Already we are compelled to procure from very remote regions this precious and useful material, whose especial destination is to maintain unbroken the circulation of matter; which of course involves a sensible increase in the price.

It is therefore to be lamented that a large quantity of bones remain unutilised for this great purpose from indolence or ignorance, and another from deeply-rooted religious prejudices. Invitations and proposals to obviate these evils have not been wanting, and especially as regards the last-mentioned point, they were to be found at the Exhibition. Thus Cav. Ludovico Brunetti, Professor of Pathological Anatomy at Padua, exhibited an apparatus for the incineration of dead bodies, together with the residue from the combustion of a corpse which had weighed 45 kilos. (No. 4149). The weight of the whitish residue was 1077 grms.; the process of combustion lasted three and a half hours, and the expense was merely 1·2 Austrian gulden.†

The quantity of bone-earth remaining on the incineration of bones varies according to age and to the part of the body to which they belong. On an average it is about 59 per cent. Its composition is:—

Calcium phosphate, $Ca_2(PO_4)_2$ ..	85·7
Magnesium phosphate	1·7
Calcium carbonate	9·1
Calcium fluoride	3·0
	99·5

As, however, 100 kilos. of bones yield, at most, 8 kilos. of phosphorus, more than two-thirds of the total amount present in the bones remaining in the residues, it appears that for the production of the quantity of phosphorus required a very considerable amount of bones is required, as shown in the following figures. R. Wagner states in his valuable "Yearly Report" (xi., 267), that in the year 1864 to 1865 the production of phosphorus was:—

	Kilos.
In France and Italy	100,000
In Germany and Austria ..	90,000
In England	75,000
	265,000

for which 3,312,500 kilos. of bones were required. For the present time these figures are far too low, as will appear from the statistics of the French match trade, as given below.

Hence, it appears that in the preparation of phosphorus as generally carried on a valuable material is consumed in a profligate manner. The endeavours of chemists to utilise it more thoroughly, are, therefore, still continued. On the one hand, the manufacture of animal charcoal or bone-black, an article of great importance in sugar refining, and in many other branches of industry, has been greatly improved, the bones, previously freed from fat, being now heated, not in iron crucibles, but in horizontal cylinders, such as are used in the manufacture of coal-gas.* As by-products are obtained carbonate of ammonia, the consumption of which is daily on the increase, as also animal tar and a lighting-gas of very good quality. The tar is as yet a mere burden to the manufacturers, since it has not yet been brought into use, and is therefore disposed of by burning, which is not without difficulty. The time is, however, certainly not far distant when a product so rich in basic nitrogenous compounds will find a profitable utilisation.

Where circumstances admit the animal charcoal, after being used for clarification, is incinerated, and the ash is further utilised. Or the recent bones are treated with hydrochloric acid to extract the phosphates, and the residual cartilage is used in the glue manufacture. Upon this H. Fleck founded a very rational process,† which A. W. Hofmann has already discussed in Report, but which does not yet appear to have been universally introduced, though the objections raised on account of the want of suitable vessels for the evaporation of the lyes might not be insuperable.

Similar has been the fate of Metrand's ingenious proposal to act with hydrochloric acid gas upon an intimate mixture of equal parts of bone-ash and wood-charcoal, thus obtaining phosphorus, a method also mentioned by Hofmann. Instead of bone-ash a natural phosphate might serve, or one prepared by precipitating the hydrochloric solution of bones with lime. The chloride of calcium thus obtained could be used without difficulty for the reproduction of hydrochloric acid, so that the final result would be sulphate of lime containing a small proportion of phosphates, which might be very well utilised as manure.

Recently the process suggested years ago by Wœhler to decompose phosphate of lime with silica and carbon has been carried out on the large scale at Coignet's works in Lyon, having been re-discovered by Aubertin and Robiquet.‡ We must not forget that Brand first obtained phosphorus by distilling urine previously evaporated to dryness with sand.

Brisson has modified Wöhler's process by adding soda to the above-mentioned mixture, and heating in a shaft-furnace. The operation must be managed in such a manner that the liberated phosphorus may not come in contact with the air, which is not very easily arranged.§

In England sombrerite, which is found abundantly in the Antilles, and especially in the island of Sombrero, is said to be used for obtaining phosphorus. It consists of 49·6 phosphoric acid, 42·7 lime, 6·5 alumina, and 1·1 moisture.‖

Another West Indian mineral known as Redonda phosphate is used in England, consisting chiefly of alumina and phosphoric acid, along with some iron. Spence opens up the mineral, after ignition and pulverisation, by boiling with sulphuric acid. By the introduction of ammonia

* "Berichte über die Entwickelung der Chemischen Industrie Wahrend des Letzten Jahrzehends."

† See Brunetti's work "Cremazione dei Cadaveri;" also Dr. J. P. Trusen's "Die Leichenverbrennung als die geeignetste Art der Todtenbestallung," Breslau, 1855: and, finally, an excellent article by Sir Henry Thomson in the *Contemporary Review*, January, 1874, in which the subject is considered from the sanitary and economical points of view. (See *N. fr. Presse F.*, 1874, No. 40). The best success must therefore be wished to the exertions of the recently-formed Cremation Society of Hamburg.

* G. Lunge's description of the process of bone-distilling introduced in England. *Wagner Jahresber.* 1867, 199; *Dingl. Pol. Journ.*, clxxiv., 513.

† "Verbessertes Verfabren der Phosphor Fabrikation." Hugo Fleck. Leipzig, 1855. See *Wagner Jahresber.*, 1855, 66.

‡ *Montcurs Scientif.*, 1869, 173.

§ *Wagner Jahresber.*, 1869, 223.

‖ *Wagner Jahresber.*, 1862, 237. An attempt has also been made to use phosphate of iron instead of phosphate of lime in the preparation of phosphorus. Details are not known and success is improbable.

from gas-liquors ammonia-alum is formed and readily removed by crystallisation. The mother-liquor contains principally phosphate of ammonia, which may be used in the manufacture of manure.

Gerland extracts bones, previously deprived of fat, with sulphurous acid, and heats the solution when the phosphates are deposited, whilst the acid escapes and may be re-used.* This process appears to be in use in France, where patents for its execution have been taken out by several manufacturers.†

As far as the reporter is aware the total supply of phosphorus is furnished at present by two establishments only; the firm of Albright and Wilson, of Oldbury, near Birmingham, and by Coignet and Son, of Lyon. O. Pauli, who formerly managed the works of Schattenmann, at Buxweiler, near Strasburg, produced there, and subsequently in his own manufactory at Karlsruhe, phosphorus of excellent quality, and employed Seubert's ingenious process for drawing the product into rods. According to recent intelligence the manufacture there has been abandoned, and in general no phosphorus is produced in Germany, a fact evidently depending on the price of the raw material.

In Austria, also, phosphorus is at present no longer produced. Ploy formerly fitted up a manufactory at Obernberg, in Upper Austria, and, subsequently, in 1849, at Manning, in the same province; but the production, which amounted to 250 cwts. annually, ceased in 1865. Another establishment was opened in 1853 by Baron Riese-Stallburg, at Wranowitz, in the circle of Pilsen, in Bohemia, where about 180 cwts. of phosphorus were yearly produced. This manufactory also was discontinued in 1865.

The firm of J. D. Stark, who, in 1847, introduced the manufacture of phosphorus on the large scale at their works at Kasnau, in Bohemia, have also abandoned it in 1868. In a pamphlet issued by opportunity of the Exhibition under the title "The Firm J. D. Stark, their Mines, and Manufactories of Mineral," compiled by A. Prochaska, manager of the works at Kasnau, the reason alleged was the high price of bones, due to the great development of the sugar manufacture in Austria, and especially in Bohemia, and to their consumption in agriculture both as bone-dust and in artificial manures. A second reason why the establishment could not compete with England in the price of phosphorus might possibly be found in the circumstance that Messrs. Stark obtained from 25 to 26 cwts. of bones only 1 cwt. of phosphorus, *i.e.*, 4 per cent, while in England 8 per cent are extracted. The cause of this loss was that the gases on their exit from the retort had to overcome a pressure, which, though slight, was sufficient to facilitate the escape of the vapour of phosphorus through the porous sides of the retort.

The applications of phosphorus are so numerous that it is scarcely possible here to enumerate them all. Its greatest consumption by far is in the manufacture of matches. But it is difficult to form a correct estimate of the extent of this application. If we take as a basis the statements *Compagnie Generale des Allumettes Chimique*, according to which the consumption in France is 360 tons, and if we assume that in the rest of Europe only double the quantity is used for the same purpose, it appears that the match trade requires the serious amount of 1080 tons, = 1,080,000 kilos. This calculation, however, is merely approximate. Nor are we able to check it either by the number of matches yearly produced or by the quantity of the inflammable mass used in their preparation, since both these factors are unknown. As regards the amount of the inflammable mixture especially accounts vary very widely, its proportion of phosphorus being given as low as 6 and as high as 40 per cent. Thus, according to M. Hochstätter, of Langen, 15 grms. of mass containing 7 per cent of phosphorus suffice for 1000 matches, whilst according to M. Pollak, 31 grms. of a mass with the same percentage of phosphorus are required for the same. These discrepancies are intelligible if we consider the different sizes of the matches and the unequal bulk of their heads. As to the above-mentioned quantity of 1080 tons of ordinary phosphorus the amorphous must be added, which is now consumed to a not inconsiderable extent for the Swedish safety-matches, and also the consumption for other purposes, the amount of phosphorus yearly required may be estimated at 1200 tons, for the production of which 15,000 tons of bones are consumed if the yield is assumed at 8 per cent.

The Match Trade.—No fewer than 40 firms exhibited matches at Vienna, but not one of them has produced any decided novelty. The attempts of manufacturers have been almost exclusively directed to a pleasing appearance, the increase of production, and the reduction of price. The great bulk of matches are still made with ordinary phosphorus. Next in number, though at a great distance, follow those which can be struck only on a peculiar surface prepared with amorphous phosphorus.

Matches tipped with a mixture containing amorphous phosphorus, and capable, therefore, of being ignited on any surface, were exhibited only by one firm, H. Hochstätter, of Langen, near Frankfurt on the Main.

Matches of this kind were even displayed at the London Exhibition of 1851, but met with no approval as they were not easy to strike, and their ignition was often attended with a slight explosion and the projection of sparks. The matches of this kind exhibited by the Viennese firm of Forster and Wawra at Paris, in 1867, still suffered from the same defects, though in a smaller degree.*

H. Hochstätter has finally succeeded in the complete solution of the problem, which the present reporter attempted twenty-six years ago, as may be seen from the report on the matches displayed in the London Exhibition of 1872, to which he therefore refers.†

(To be continued.)

ALUMINIUM PLATE AS A SUPPORT IN BLOWPIPE WORK.

By W. M. HUTCHINGS.

Those who are in the habit of using the blowpipe, either for the determination of minerals or for the preliminary examination of substances for detailed analysis, will be well aware how difficult it is to obtain suitable pieces of charcoal for sublimates, and how expensive they are even when they can be got at all. They are also very bulky and inconvenient to carry when one wishes to use blowpipe apparatus in travelling.

For these reasons various suggestions have been made for economising and partially replacing them. Foster introduced a slab of unglazed porcelain, of the size and shape of a good piece of natural charcoal, having at the ends cavities into which fit small pieces of charcoal on which to place the assay. The surface of the porcelain is blackened by holding it down into the flame of the lamp, and receives the sublimates in the same manner as a long piece of charcoal. This answers the purpose very well, and a piece of charcoal which by itself would only

* The firm of B. Forster and F. Wawra is, since 1871, known as F. Wawra and A. Kempny. It is unfortunate that this firm, one of the oldest in Austria and the direct successor of Th. Preschel, did not exhibit. The works occupy a surface of 2381 square metres, employ 160 persons, and produce yearly 2560 millions of matches. The dextrin required in the mixture is made on the premises. The establishment has ceased making matches with amorphous phosphorus, as the demand was insufficient.

† Space does not allow of a repetition of the history of the match trade. It may be found in A. W. Hofmann's "Report" for 1862, that of the writer for the same occasion; in the copious "Report" of Dr. Heidenhaus on matches in the Paris Exhibition of 1867; and in the "Report" of the General Direction on Matches and Explosives at the Vienna Exhibition of 1873. See also Thiel's paper in *Wagner's Jahresbericht*, 1866, 74.

[illegible] 67, 1870.

serve a few times, with the trouble (and dirt) of cleaning the used surfaces with a rasp, will cut up into a large number of the small pieces required on this support.

Mr. Fletcher, of Warrington, suggested to me the use of porcelain plates having a small ledge at right angles for the support of a bit of charcoal, so held that the blackened surface for receiving sublimates should be almost vertical, after the manner of the aluminium plate introduced by Major Ross. This would be better than either long pieces of charcoal or Foster's support, as it is undoubtedly far preferable to catch the sublimates on a vertical, or almost vertical, surface.

But by far the best support, in every way, is the above-mentioned aluminium plate just used by Major Ross, and described by him in his book "Pyrology." Having worked for some time with this, and after long and careful trials, and comparisons with charcoal, having found it so very excellent and useful, I think some remarks on it may be of service to those who have not yet tried it. I have reason to believe that its use is still very little known, and it is certainly a pity that anybody should continue using charcoal when there is something so much superior to be had. Probably many people, like myself, when they first read about it, were incredulous as to a piece of polished aluminium-foil being suitable for the purpose, or were alarmed at the rather elaborate polishing and burnishing during use which Ross directed to be applied; and so stuck to the old charcoal or the porcelain substitute. But it is a fact that the aluminium *does* stand the work perfectly; and in practice, after once polishing the new plate, all the cleaning required is done in half a minute with a bit of wash-leather and some fine-ground bone-ash and water. In many cases just the wet leather is sufficient.

I propose in the following notes to point out some of the advantages of aluminium-plate as observed during my own work, and finally to give a list of sublimates of those metals the behaviour of which on charcoal is given in Prof. Richter's edition of Plattner. Most of this is simply confirmatory of the descriptions given by Major Ross in his book and elsewhere, the only value consisting in the fact of those now given being from a careful lot of independent observations, and in their being drawn together into a systematic list, which will be of use to anybody who may wish to try the aluminium for the first time, and may not be valueless even to those who already use the method, but who have not troubled to make out a complete table of results.

The plate is not only a great gain as to portability, cleanliness, and expense, but also gives, in most cases, much better indications of the volatile substances sought for.

The only charcoal required with it is a stock of small pieces, about half an inch square and rather thicker than a penny-piece, which can easily be cut ready, and, if necessary, carried in large numbers. The best aluminium for the purpose is about the thickness of a sixpenny-piece. A strip of such foil should be got, 5 inches long by $1\frac{1}{4}$ inches wide, and one end should be turned up to form a ledge, as directed by Ross, this ledge being between $\frac{1}{2}$ and $\frac{3}{4}$ inch wide, and making rather less than a right angle with the rest of the plate. Sheet-aluminium, even of much greater thickness than this, can be bent easily without any cracking by heating it in a Bunsen burner and working it while hot. It can be had of any thickness and dimensions required, of Messrs. Johnson, Matthey, and Co., for 7s. 6d. per ounce. After turning up the ledge, and rounding off the edges and corners with a file, the plate should be well scoured with bone-ash and polished with leather and whiting.

When in use it is best held with the spring-forceps described by Ross, though other forceps can be made to serve the purpose, the handles being covered with felt or flannel, as they get very hot. It is held so as to be almost vertical—only just enough inclined to prevent the assay and the slip of charcoal from falling off the ledge. A little practice enables the worker to hold it quite steadily, with as much ease as he does the ordinary piece of charcoal.

Such a plate will cost about 3s. 6d., and will last any length of time. The blowpipe-flame does it no injury (not even a good powerful one worked by a small hand-blower), and there is scarcely any substance which may not be heated directly upon it with perfect safety. The one side being kept for sublimates, the other may be used for such purposes as calcining sulphides, &c., before testing in beads, for which it is far superior to charcoal, especially in the case of very fusible minerals.

The principal advantages of the aluminium are—

1. It enables us to get several sublimates in succession from the same fragment of substance. Heated very gently on the bare plate, only the most volatile constituents are given off. As the heat increases more and more is given off, but a limit is reached beyond which nothing is obtained, the less volatile constituents not being given off at all, or only very slightly, as long as the substance is cooled by lying direct on the aluminium. The same fragment being then placed on a slip of charcoal on the ledge, these less volatile constituents are obtained in the separate sublimate.
2. The sublimates are mostly much more concentrated on the aluminium as compared with ordinary charcoal, which, when exposed to the flame for any length of time, gets red-hot a long way in front of the assay. The aluminium remains comparatively cool; and the vertical surface prevents the sublimates being swept along by the blast so much as on the nearly horizontal charcoal.
3. When the sublimate is once formed the aluminium has no further action upon it, and many very characteristic changes may be observed by applying an oxidising or reducing flame, most of which cannot be obtained at all on charcoal, partly because its being black would hide them, but chiefly because it immediately begins to glow under the sublimates when the flame is applied to them.

The best way to work is as follows:—A fragment of the substance, about half the size of a small pea,—or, if it decrepitates, a corresponding amount of powder made to a paste with water,—is laid upon the ledge close up to the angle, and heated very slightly, about half an inch from the tip of a pure blue flame, with gentle blast, which is blown down on to the assay at a rather steep angle. Any sublimate obtained should be examined from time to time, the heat being increased after each examination, till finally very little or nothing more is obtained. The sublimates are then cleaned off, the same fragment of substance is placed on one of the slips of charcoal, in a small cavity in its centre, and again gradually heated and the sublimate examined as before, till finally, in the strongest heat, nothing more is given off. The flame should always be so applied that its tip does not come nearer than half an inch to the assay as long as any sublimate is obtained, and only in cases where nothing is given off should it be brought so that the tip of the blue cone covers the assay. The reason for this is, that some of the sublimates are so very susceptible of reducing action that if the flame were brought up too close they would be altered before they could be observed.

If no sublimate is obtained, either in the O.F. or in the blue tip, the powdered substance should be mixed with its own bulk, or rather more, of sodium carbonate, and the paste heated on charcoal-slip within the blue tip.

Whenever a distinct sublimate has been obtained the assay is removed from the paste, and further examination made as follows:—

1. The sublimate is held about $1\frac{1}{2}$ inches in front of a pure and moderately strong flame, and the behaviour of its various portions noted. This is what Ross calls the "peroxidising pyrocone." It produces many effects of oxidation which cannot be obtained

in what is usually termed the "oxidising flame," close to the tip of the blue. As it would be convenient to have a special name for it, it might be called the "peroxidising flame" (preferring our old and short friend "flame" to "pyrocone"), and have the symbol P.F.

2. The sublimate, after the application of P.F., is brought up so that the tip of the blue cone flattens against it on the plate, and the behaviour of the various portions again noted. Only a very pure flame is of any use for this, as the least streak of yellow in it causes instantly a sooty mark, which might be mistaken for some of the reductions produced; though such sooty marks are distinguished by their instant disappearance in O.F.

(To be continued.)

THE GRAHAM-BELL TELEPHONE.

On the 31st of October Prof. Graham Bell read a most interesting paper on his Articulating Telephone before the members of the Society of Telegraphic Engineers, Prof. F. Abel, C.B., F.R.S., the President of the Institute, being in the chair.

Prof. Bell commenced his paper by giving an account of the manner in which he was led to the study of the question of the transmission of the human voice to a distance by electricity, through having to make a number of experiments on the human voice for his father, Prof. Melville Bell, the inventor of the system of Phonetics known as Visible Speech. While prosecuting these researches he was led to repeat Helmholtz's experiments on the measurement of the number of vibrations giving rise to the vowel sounds, by setting reeds in motion by electrical currents. The idea at once occurred to him that if he could transmit vowel sounds through a few inches of wire they might also be sent to a distance of several miles, and that the principles which applied to vowels applied with equal force to consonants. After much patient experiment Prof. Bell was at last able to converse freely with his assistant, at a distance of several hundred yards, by means of an ingenious but exceedingly complicated piece of apparatus.

The lecturer next described how he threw away first a lever, then a reed, next a battery, until finally—by descending steadily from complexity to simplicity—he has reduced the articulating telephone to its simplest expression. The very last portion of the apparatus discarded was the soft iron keeper attached to the attracting end of the magnet. In the latest form of instrument the magnet attracts the diaphragm direct, without the intervention of any armature. As it stands, the instrument could hardly be more simple than it is; in fact it is difficult to believe—except from actual optical and aural observation—that a magnet as thick as one's thumb and twice as long as one's finger, a coil of covered wire, and a diaphragm of iron a little larger than a crown piece, are all that is necessary to convey distinct articulate sounds to remote distances. The Graham-Bell telephone, as manufactured by the Silvertown Gutta-percha and Telegraph Company under the direction of Prof. Bell, may be carrried in one's trousers pocket. It consists of a cylindrical steel magnet, 6 inches long, fixed into a wooden case; on the attracting end of the magnet is a coil of covered wire, the terminals of which are connected with a corresponding coil on the twin instrument. A diaphragm of soft iron, as thick as a piece of cheap note-paper, is fastened on the open end of the mahogany tube at an infinitesimal distance from the magnet, an ordinary wooden mouth-piece being screwed on over all.

Prof. Bell's lecture was listened to with marked attention by a crowded and distinguished audience, who frequently interrupted the speaker with loud bursts of applause. Incidentally Prof. Bell mentioned some singular facts with regard to the working of the telephone which he candidly acknowledged he could not explain; for instance, absolute insulation does not seem necessary, for he had transmitted sounds through a line of railway metals which were far from being in continuous contact. Strangely enough the sounds were continually confused by the action of a telegraph-wire 40 feet off, through which messages were constantly passing. Another instance of the extreme sensibility of the telephone to external disturbances came under the observation of Prof. Channing, of Brown University, Providence, Rhode Island, whose private house is joined to the College by about a mile of well-insulated wire. While communicating with his assistant, they both heard distinct sounds of singing passing through the instrument. To the songs succeeded piano-playing, the whole of the sounds being so distinctly conveyed that the Professor took a list of the pieces which were sung and played. Next day he advertised the list in the Providence papers, requesting information as to the exact house in which the performance took place, so that he might investigate the matter fully: his letter to Prof. Bell was, however, despatched before the desired information had arrived. With respect to the vibration diaphragm it was at first supposed that very thin iron leaf must be used, but Professor Bell has transmitted sounds with equal facility by using a diaphragm of boiler-plate three-eighths of an inch thick, and 12 inches in diameter. From this singular circumstance he infers that the diaphragm does not vibrate in mass, but that the motion set up is purely molecular. This fact, and the inference deduced from it, opens up a vista of speculation as to the nature of sound, into which it would be out of place to enter here; we confine ourselves, therefore, to stating the fact. Professor Bell also described how a telephone could be worked without the intervention of a permanent magnet at all by employing a soft iron rod suspended in the magnetic meridian and the line of dip. This, we believe, is the first time in which the force of the earth's magnetism has been used to convey messages to a distance. In practice it is, of course, much more simple to use a permanent magnet. A musical telephone was also exhibited, but as it has not yet passed beyond the experimental stage it would be unfair to criticise its performance.

After the lecture Colonel Rennel descended to the basement, and kept up a lively conversation with Prof. Abel, Prof. Stokes, Messrs. Latimer Clark and Preece, and several other well-known electricians, all of whom declared that they heard everything perfectly, and gave Colonel Rennel's answers to the questions put to him *viva voce*. The latest telegrams were also read by Prof. Bell's assistant in the basement, and repeated to the audience by the President.

On the proposition of Mr. Latimer Clark, seconded by Mr. Preece, a vote of thanks was carried to Prof. Bell by acclamation.

In the course of his lecture Prof. Bell mentioned a curious instance of the *misuse* of the imagination in matters of science. When his first instrument for the transmission of articulate sounds was, as he thought, perfect, he put the question to his assistant, "Do you hear what I say." The answer that Professor Bell heard was "Perfectly?" but on afterwards comparing notes it was discovered that neither had used the words that the other had heard, or, to put it more plainly, each had heard exactly what he expected to hear and not what the other had said.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 1, 1877.

Dr. J. H. Gladstone, F.R.S., President, in the Chair.

The minutes of the previous meeting were read and confirmed. The list of presents to the library was read, and

the thanks of the Society given to the respective donors. The following certificates were read for the first time:—W. J. Williams, W. D. Harland, A. H. Elliott, H. R. Hind, H. B. Nason.

The following papers were communicated to the Society:—

"*On some Hydrocarbons Obtained from the Homologues of Cinnamic Acid, and on Anethol and its Homologues*," by W. H. Perkin, F.R.S. (1.) Considerable quantities of cinnenyl-acrylic, crotonic and angelic, and phenyl-crotonic and angelic acids were prepared. The hydrocarbons were at first obtained by decomposing the acids by heat, afterwards the process proposed by F. Binder, viz., treating the hydrobromo acids with bases was found to yield more satisfactory results. A solution of hydrobromic acid in glacial acetic acid instead of an aqueous solution answered very well. The following acids were prepared and examined:—Hydrobromo-cinnenyl-acrylic acid,—

$$C_{12}H_{13}BrO_2;$$

fuses 85° to 87° C. Hydrobromo-cinnenyl-crotonic acid, $C_{13}H_{17}BrO_2$; crystallises in flat oblique prisms, fuses at 148° to 150° C.; on further heating HBr is evolved. Hydrobromo-cinnenyl-angelic acid, $C_{14}H_{19}BrO_2$. All these hydrobromo-acids, when treated with a cold solution of sodium carbonate or potassium hydrate, decompose, hydrocarbons being produced as follows:—Isopropyl-vinyl-benzene boils at 203° to 206° C.; sp. gr. at 15° 0·8902; heated for a few hours to 150° C. it solidifies to a transparent glassy mass. This change also takes place slowly at ordinary temperatures in daylight. The properties and chemical reactions of this substance are given. The dibromide was prepared, fusing at 71°. Isopropyl-allyl-benzene boils at 229° to 230°; sp. gr. at 15° 0·890; does not solidify at −15° C.; its formation may be represented thus:—

$$\underbrace{C_6H_4(C_3H_7)CH.CH.OH_2COOH}_{\text{Cinnenyl-crotonic acid.}} = \underbrace{C_6H_4(C_3H_7)CH.CHCH_3}_{\text{Isopropyl-allyl-benzene.}} + CO_2,$$

or—

$$\underbrace{C_6H_4(C_3H_7).CH_2CHBr.CH_2COOH}_{\text{Hydrobromo-cinnenyl-crotonic acid.}} = C_6H_4(C_3H_7)CH.CHCH_3 + HBr + CO_2.$$

Its dibromide was obtained by shaking the hydrocarbon with bromine. It melts at 59° to a colourless oil, crystallising beautifully on cooling. Isopropyl-butenyl-benzene is a colourless oil, boiling at 242° to 243°; its sp. gr. at 15° is 0·8875. It resinifies if kept in contact with the air; its dibromide was prepared melting at 77°. Allyl-benzene boils at 174° to 175°; sp. gr. at 15° 0·9180; when heated between 160° to 200° for sixty hours it did not undergo any visible change; its dibromide was obtained as a crystalline mass, fusing at 67°. Butenyl-benzene, a colourless oil, boiling at 186 to 187° C.; a dibromide was prepared crystallising in needles, melting at 67°. The two last-named hydrocarbons have already been obtained. Allyl-benzene by L. Rügheimer (*Journ. Chem. Soc.* p. 894, 1874); it has the same constitution as the body prepared by the author. The butenyl-benzene, however, prepared by B. Aronheim (*Deut. Chem. Ges. Ber.* v., 1068), is isomeric with the one now produced. (*b.*) On gently boiling methyl-paroxy-phenyl-acrylic acid an oil gradually distils over, having a fennel-like odour. This body, after purification, had the formula $C_9H_{10}O$; the author proposes to call it vinylic-anethol; it boils at about 201° to 202°, melts at about −1° to −2°. Its formation may be represented thus—

$$C_6H_4(OCH_3).CH.CHCOOH = C_6H_4(OCH_3).CH.CH_2 + CO_2.$$

An endeavour was made to prepare this substance Binder's reaction, but without success. On heating methyl-paroxy-phenyl-crotonic acid an oil distils over carbonic acid being evolved; by fractional distillation freezing and pressing the mass thus obtained between blotting-paper perfectly pure allylic or ordinary anethol was obtained, identical with that obtained from oil of anise. By heating methyl-paroxy-phenyl-angelic acid, butenylic anethol is obtained in an impure state, but by treating the hydrobromo-derivative of that acid with sodium carbonate, &c., perfectly pure butenylic anethol is obtained; it is crystalline, fusing at 17° C., boiling at 242° to 245°; sp. gr. at 30° 0·9733; formula $C_{11}H_{14}O$. In conclusion the author discusses the formation of the hydrocarbons from the hydrobromo-acids by heating with sodium carbonate; he finds that silver nitrate in aqueous solution, sodium acetate, and, in some cases, even water, may be substituted for sodium carbonate, and yet the hydrocarbon be formed, and concludes that the hydrocarbons are formed simply by the separation of hydrobromic acid and carbonic anhydride. The author remarks that only the hydrocarbon and anethol containing vinyl polymerise when heated, and form compounds corresponding to meta-cinnamene; also their boiling-points differ much more from those of the compounds containing allyl than do the latter from those of the butenyl compounds.

Dr. Gladstone said that the Society had rarely listened to a research so productive of new and interesting substances, and pointed out the interesting results which would probably be obtained by an examination of the refraction and dispersion of these new bodies.

The thanks of the Society were then given to the author for the above paper.

Dr. Armstrong then read a paper by M. M. P. Muir, "*On two New Methods for Estimating Bismuth Volumetrically*." Chancel has shown (*Jahresber.*, 1860, 612 that bismuth is precipitated in the form of phosphate by the addition of a soluble phosphate to a solution of the metal in nitric acid. Both processes are based on this fact. In the first, bismuth is thrown down from nitric acid solution, after partial neutralisation with ammonia, by addition of a standard solution of sodium phosphate; the final point of the reaction is determined by spotting the supernatant liquid on a slab with warm ammonium molybdate solution. The results are approximately accurate. In the second process the nitric acid solution of bismuth is mixed with an excess of sodium acetate, a measured volume—excess—of standardised sodium phosphate is added, the liquid boiled, and filtered, the precipitate is well washed with hot water, and the excess of phosphoric acid determined in the filtrate by titration with a standard solution of uranium acetate. The results are very accurate. This second method is much to be preferred to the first, and is much more satisfactory than the author's dichromate process (*Journ. Chem. Soc.*, i., 483, 1876).

The next paper was also read by Dr. Armstong "*On the Oxidation of Ditolyl*," by T. Carnelly, D.Sc. Last year in the production of tolyl-phenyl the author obtained a quantity of liquid and solid ditolyl as a by-product; by fractionating, solid ditolyl, melting at 121° C., and two liquid ditolyls, boiling about 275° and 285°, were obtained. These substances were oxidised with chromic and glacial acetic acids. Solid ditolyl gave on oxidation, first, di-para-tolyl-phenyl-carbonic acid,—

$$C_{12}H_{18}\begin{cases}CH_3\\CO.OH\end{cases},$$

as a white powder, melting with blackening at 244°; and secondly, dipara-diphenyl-dicarbonic acid,—

$$C_{12}H_{18}\begin{cases}CO.OH\\CO\ OH\end{cases}.$$

The two liquid ditolyls gave identical results on oxidation, first, ortho-para-tolyl-phenyl-carbonic acid,—

$$C_{12}H_{18}\begin{cases}CH_3\\COOH\end{cases},$$

a white powder, melting at 176° C.; secondly, ortho-para-diphenyl-carbonic acid,—

$$C_{12}H_{18}\begin{cases}COOH\\COOH'\end{cases}$$

a white powder, which sublimes before fusing, and finally terephthalic acid. The above experiments show that when sodium acts on a mixture of para- and ortho-bromtoluene two isomeric ditolyls are produced, the dipara and ortho-para compounds. The author gives graphic formulæ showing the constitution and relations of the above bodies, and concludes by stating that he hopes to be able to prepare the diortho-ditolyl from it, obtain by oxidation diphenic acid, and thus confirm the constitution of phenanthrene.

The last paper was entitled "*Note on a New Manganese Reaction*," by J. B. HANNAY. When a solution of a manganous salt in strong nitric acid is warmed, with the addition of crystals of potassic chlorate, the whole of the manganese is precipitated as manganous manganate. If a salt of iron be present a double manganate of iron and manganese, $2Fe_2(MnO_4)_3$. $MnO.MnO_3.12H_2O$, is precipitated; no other metals seem to be precipitated with manganese under the same conditions. The precipitate is insoluble in nitric and sulphuric acids, and unattacked by caustic alkalies. Hydrochloric acid acts on it, and reducing agents rapidly decompose it. Sulphurous acid first attacks the iron, setting free manganese dioxide, which rapidly collects into little nodules having a considerable degree of coherence. The manganese slowly disappears, the final reaction being—

$$Fe_2(MnO_4)_3+6SO_2=Fe_2(SO_4)_3+3MnSO_4.$$

The principal interest in the above reaction is that it furnishes a good method of separating iron from aluminium, &c., without the use of pure caustic soda. The iron compound appears, under the microscope, as thin flexible plates, of a purple brown colour.

Mr. GROVES remarked that nothing was said by the author as to the effect of the presence of phosphoric acid on the reaction.

After the thanks of the Fellows had been given to the authors of the above papers the Society was adjourned to November 15, when the following papers will be read:—"On Gallium," by Prof. Odling; "First Report to the Chemical Society on some Points in Chemical Dynamics," by Dr. Wright and Mr. Luff; "On the Influence Exerted by Time or Mass in Certain reactions in which Insoluble Salts are Produced," by M. M. Pattison Muir; "On two New Fatty Acids of the Series $C_nH_{2n}O_2$," by C. T. Kingzett.

PHYSICAL SOCIETY.

November 3, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidate was elected a member of the Society:—Alexander Jessemann.

Prof. MCLEOD described some experiments he has recently made to determine the exact number of vibrations of tuning-forks by means of the apparatus he exhibited to the Society on the 28th of April last, which was designed for determining slight variations in the speed of machinery or other analogous purposes. He has studied two sets of forks belonging to the Physical Laboratory at South Kensington, and a new set just received from Kœnig, and his results exhibit a remarkable concordance, the extreme results in the worst set of observations on a fork of 256 complete vibrations only differing by 0·005 per cent; and in a good set they agreed within 0·00078 per cent. Examining the new series, from 256 to 512, he found them in all cases to give from 0·3 to 0·5 of a vibration more than was anticipated, but as this variation may be due to a difference between the temperature and that at which they were adjusted, he is waiting to ascertain what this was. In reply to an enquiry of Dr. Guthrie, he stated his belief that a change in all probability does take place in the molecular condition of a fork with age. He considers also that the manner in which the fork is held has an effect upon its vibrations, and he hopes to be able to get some information as to the effect of temperature on elasticity.

Dr. HUGGINS exhibited some artificial gems recently prepared by M. Feil, the well-known glass manufacturer of Paris. He has succeeded in crystallising stones of the corundum class; and rubies, as well as a topaz and emerald, were exhibited. Dr. Huggins believes that the colour is imparted by small quantities of metallic oxides, and that the mass is mixed with boracic acid and maintained in a fused condition for a considerable period. M. Feil hopes to obtain larger stones by maintaining the heat constant for several weeks consecutively.

Dr. LODGE then read a communication from Profs. AYRTON and PERRY, of the Imperial College, Japan, in continuation of one read to the Society on the 26th of May last, on "*Ice as an Electrolyte*," and since published in the *Philosophical Magazine*. The experiments therein described led them to expect a very sudden rise in the specific inductive capacity as the temperature of the ice increased through zero, and it became water. Recent results have shown that, though rapid, this increase is not as great as they anticipated, and, whereas at −12° C. the capacity is 0·002 microfarad, at +5° C. it is 0·1185 microfarad, and after this temperature the increase was so rapid as to render exact readings difficult. Referring to Prof. Clerk Maxwell's theory, comparing electromagnetic disturbances with light vibrations, they point out that he exclusively regards a conducting medium. But they showed in a former paper that no dielectric can be considered non-conducting, hence they conclude that the measured specific inductive capacity can never be even approximately equal to the square of the index of refraction.

Prof. FOSTER mentioned that he recently had occasion to collect as many results as possible on specific inductive capacity and refractive index, and he found that where these figures were low the agreement with the law was fairly close, but with greater values the inductive capacity and the square of the refractive index separate very rapidly.

Prof. GUTHRIE described a simple means for showing the interference between plane waves by means of two long cords vibrating side by side. If a vibration of considerable amplitude be imparted to them and the plane in which they travel be carefully examined two faint black lines will be seen, which cross and re-cross each other more rapidly as the cords are less and less in unison, and with perfect unison remain stationary.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

October, 1877.

THE following communications have been received during the vacation of the Society:—

A. NAUMANN, "*Distillation of Aromatic Hydrocarbons by means of Steam.*" The author describes a variety of experiments conducted with the view of determining the boiling-points of mixtures of water and hydrocarbons and the relative amounts distilled over. The results show that constant boiling temperatures prevail when steam is introduced into benzene, toluene, or xylene—viz., 68·5°, 82·4°, and 89°—independent of quantity or rapidity. These boiling-points are in all cases less than those of the hydrocarbons, and in all cases the temperature of the vapour was 0·6° to 2·5° higher than that of the liquid from which it proceeded. The ratios between the amounts of water and of hydrocarbons in the distillates was in each case

constant. 100 vols. of water were accompanied by 8·5 of benzene, 21·2 of toluene, or 44 of xylene.

G. Lunge, "*Denitration of Nitrosyl-sulphate by Sulphurous Acid.*" Experiments are described which were designed to test the truth of Kuhlmann's and Vorster's statements, that in the Glover's tower an extensive reduction of NO to N_2O, and even N, took place, and consisted essentially in conducting measured volumes of air and SO_2 over chamber-crystals heated to 110° to 200°, and then over sulphuric acid, the outflowing gases being carefully measured. The results showed that by this process, identical with that occurring in the pyrites furnace, the nitrosyl-sulphate is so decomposed that the entire amount of NO_2 is won back by absorption in the sulphuric acid, even when the heat mounted to 200°. No loss by the formation of N or N_2O was noticed also under 130°, when SO_2 alone passed over the crystals and the oxidation of the NO took place later, although quite noticeable at 200°.

A. v. Grote and B. Tollens have repeated their investigations on "*Levulic Acid*, $C_5H_8O_3$," and find it and its compounds identical in most points with the β-acetopropionic acid.

G. Vortmann describes at greater length the "*Cobalto-ammonium Compounds*" obtained by him from a solution of cobaltous carbonate in ammonia and carbonate of ammonium on treatment with HCl. They consist of octamin-purpureo-chloride, $Co_2.(NH_3)_8.(H_2O)_2.Cl_6$, crystallising into octahedrons, and easily changed into Rose's isomeric praseo-chloride; octamin-roseo-chloride, containing two additional molecules of H_2O; octamin-sulphate, carbonate, and carbonate-sulphate; violet or red crystals yielding brilliantly coloured solutions, and some already well-known bodies.

S. Natanson and G. Vortmann have prepared "*Phosphides of Tin*" by heating vitreous phosphoric acid, charcoal, and tin together, by melting tin and vitreous phosphoric acid, by conducting P vapours over molten tin in a hydrogen atmosphere, and by throwing P on molten tin. These processes all yield a whitish crystalline product, containing from 0·7 to 2·8 per cent P. Treatment with HKO left a residue of the normal phosphide SnP.

W. Thörner and T. Zincke, "*Studies on Pinacones and Pinacolines.*" From examination of benzpinacone and tolyl-phenyl-pinacone the authors observe that the pinacones by fusion are changed into the original ketones and corresponding hydrols, and that in the formation of the pinacolines from ketones pinacones appear as intermediate products.

"*Transformation of Ortho-benzyl-toluen Compounds into Anthracen Derivatives.*" By the action of Cl at 120° on tolyl-phenyl-keton an anthraquinon dichloride,—

$$C_6H_4\begin{cases}CO\\CCl_2\end{cases}C_6H_4,$$

was obtained, which is soluble in alcohol and acetic acid in the cold, but changes into anthraquinon on heating the solutions. Chlorinated anthraquinons are formed also by the action of PCl_5 on ortho-benzyl-benzoic and ortho-benzoyl-benzoic acids.

C. Wachendorff and T. Zincke, "*Methyl Derivatives of Anthracen.*" Dimethyl-anthracen, $C_{14}H_8(CH_3)_2$, has been found in high-boiling aniline residues. It melts at 225°, crystallises in yellow laminæ, and is oxidised by chromic acid and acetic acid to dimethyl-anthraquinon, $C_{14}H_6O_2(CH_3)_2$, as well as the two acids—

$C_{14}H_6O_2.CH_3.COOH$ and $C_{14}H_6O_2(COOH)_2$..

P. Hunæus and T. Zincke, "*Styrolene Alcohol.*" The oxidation-products have been studied, and found to be in the first case benzoyl-carbinol, $C_6H_5.CO.CH_2OH$, and in the second case benzoyl-formic acid, $C_6H_5.CO.COOH$. The former crystallises in large hexagonal laminæ, and possesses remarkable reducing properties. Acetic and benzoic ethers have been prepared, the latter of which is identical with the benzoate obtained on treating methyl-phenyl-keton chloride with toluen and benzoate of silver.

G. Krinos prepares "*Trimellitic Acid*," $C_6H_3(COOH)_3$, synthetically from xylidic acid, $C_6H_3.CH_3(COOH)_2$ by slowly oxidising with $KMnO_4$, and shows the position of the carboxyl groups thereby to be 1.2.4. As trimesic acid possesses the position 1.3.5, the third isomeric acid, hemimellitic acid, receives the position 1.2.4.

H. Brunner and R. Bradenburg obtain by the "*Action of Sodium on Mono-chlor-ethylen-chloride*," dichlorethylen, a reaction which explains the negative results of attempts to introduce the vinyl group into the benzene ring by means of this compound.

A. Werigo and H. Melikoff prepare "*Dichloropropionic Acid from the Chloranhydride of Glyceric Acid*" by changing it first with alcoholic HKO into chloracrylic acid, and enclosing this with HCl at 100°. The acid thus obtained is identical with that derived from chlorhydrine or allyl-alcohol-dichloride.

R. Schiff, in experiments "*On the Constitution of Pyrrol*," has prepared an acetyl-pyrrol, $C_4H_4N.C_2H_3O$, by heating with acetic anhydride. This possesses remarkable crystalline properties, easily assumes 2 atoms of Br, and is unattacked by K, Na, or C_2H_5I. These facts would seem to show the presence of an imide group in pyrrol.

H. Beckurts and R. Otto have examined the "*Action of Molecular Silver on α-dichloro-propionic Acid.*" When 1 atom of Ag acts on a molecule of the acid the reaction yields an acid similar to dichlor-adipic acid—

$$2CH_3.CCl_2.COOH + 2Ag = 2AgCl + CH_3.Cl.COOH.C...C.CH_3.Cl.COOH.$$

If 2 atoms are used an acid analogous to hydromucic acid, $C_6H_8O_4$.

J. Piccard, "*Cantharidin.*" Vapour-densities of this body show that its formula must be double to $C_{10}H_{12}O_4$. By the action of HI it is changed into cantharic acid, which possesses the same empirical composition, but is marked by strong acid properties, and has but half the basicity of cantharidin.

J. D. van der Plaats, "*Hyponitrous Acid.*" The author prepares hyponitrite of silver, AgNO, by reducing a solution of KNO_2 with sodium amalgam, neutralising with acetic acid, and precipitation with $AgNO_3$. The AgNO in the precipitate is purified by solution in dilute H_2SO_4, and precipitation by NH_3 in the form of a bright yellow powder. By addition of HCl to water containing the salt in suspension a solution of the free acid is obtained, which decomposes gradually, and disappears entirely in a fortnight.

O. N. Witt states that the "*New Dye-stuff*" lately synthetically prepared by Prof. A. W. Hofmann (Chem. News, vol. xxxvi., p. 51) is one of a series of sulpho-acids of azo-compounds of great tinctorial powers on which he is at present engaged.

F. Fischer gives a tabulated statement of the "*Composition of the Gases Emitted from Potash Furnaces*," in which the oily matter of wool is consumed.

B. W. Gerland describes at length his process for the "*Analysis of Vanadium Sulphates and their Double Salts with Alkalies.*" The solution of the salt in HNO_3 is treated with lead nitrate and alcohol for the precipitation of the sulphuric acid, and the precipitate freed from traces of vanadic acid by digestion with carbonate of ammonium or HNO_3. The filtrate is treated with NH_3 and acetic acid, and the vanadic acid precipitated with lead acetate. The precipitate is dissolved in HNO_3, the lead removed with H_2SO_4, the solution of vanadium sulphate evaporated to dryness, and then heated to a red-heat, at which temperature pure vanadic pentoxide remains. A small quantity of vanadium in the filtrate is obtained by removing the lead and repeating the process. The alkalies are determined in the final filtrate after precipitating the lead with H_2S. Water determinations are made with sodic carbonate and potassic chlorate in a combustion-tube. The author regards titration of vanadium by means of $KMnO_4$ as exceedingly accurate, and uses inversely vanadic solutions for determining the titre of $KMnO_4$ solutions.

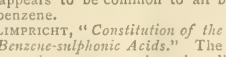
C. Böttinger obtains by the "*Decomposition of Amil-pyroracemic Acid in Water*," an acid analogous to uvitonic acid, which receives the formula $C_{12}H_{11}NO_4$. Several salts are described.

G. Reinhard prepares by the "*Action of Sulphuryl Chloride on Resorcin*" dichloro-resorcin, $C_6H_2Cl_2O_2$, easily soluble, melting at 100°, and undecomposed by distillation.

O. Wallach, "*On Chloral Derivatives.*" Dichlor-acetic ether is easily prepared pure by the action of chloral hydrate on an aqueous solution of potassic ferrocyanide, and treatment of the resultant potassic dichol-acetate with alcohol and H_2SO_4, and even more simply by the action of KOH on an alcoholic solution of chloral-cyan-hydrate. Small quantities are formed, also, when chloral-cyan-hydrate and alcohol are enclosed in tubes at 180°. The reaction with potassic ferrocyanide explains, also, the formation of mono-chloro-crotonic ether from butyl-chloral and potassic cyanide.

W. Konigs, "*Action of Sulphurous Acid and Sulphinic Acids on Diazo Compounds.*" By the action of sulphurous acid on diazobenzene sulphate the author has obtained the hydrazine compound, $C_6H_5NH.NH.SO_2C_6H_5$. The same end is reached by reducing the reaction-product of diazo-benzene-sulphate and sodium-benzene-sulphinate, $C_6H_5N_2.SO_2.C_6H_5$, which is easily prepared, and resembles in its properties alkaline diazo-benzene-sulphonates, as $C_6H_5N_2.SO_2.OK$. The reaction with the two acids appears to be common to all bodies analogous to diazo-benzene.

H. Limpricht, "*Constitution of the Diazo-Derivatives of the Benzene-sulphonic Acids.*" The author judges from the three circumstances that the diazo-derivatives of benzene-sulphonic acids are unable to unite with acids, that the diazo-compound of tetrabromo-benzene-sulphonic acid can only receive the formula—



and that the diazo derivatives of neutral salts of amido-disulphonic acids are the same as those from the acid salts; that hence in the diazo derivatives of benzene-sulphonic acids 1 atom N replaces the atoms of H in the groups NH_2 and SO_3H.

"*Decomposition of Substituted Benzene-sulphonic Acids by H_2O and Acids at High Temperatures.*" The various bromine derivatives lose the SO_3 group on treatment with acids at high temperatures. When NO_2 in addition is present the reactions are usually more complicated. In the amido derivatives the decompositions are exceedingly irregular, dibrom-aniline-sulphonic acid yielding, for example, H_2SO_4, two dibrom-anilines, and a tribrom-aniline.

C. Reischauer, "*Juglon.*" An extended series of analytical results with regard to this body, which is formed in the green shells of walnuts, are taken from the notes of this deceased chemist.

S. Gabriel and A. Michael, "*Action of Dehydrating Agents on Acid Anhydrides.*" The authors describe more fully the preparation of phthalyl-acetic acid from phthalic anhydride, acetic anhydride, and sodium acetate, and give it the formula $C_6H_4..(CO)_2..CH.COOH$. Alkalies change it into a benzoyl-acetic-carbonic acid,—

$$C_6H_4\begin{cases}CO.CH_2.COOH\\COOH\end{cases}.$$

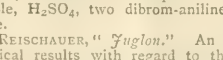
By fusion it yields an aceto-phenon-carbonic acid,—

$$C_6H_4\begin{cases}COCH_3\\COOH\end{cases}.$$

Bromine and chlorine change phthalyl-acetic acid into tribromo- and trichloro-aceto-phenon-carbonic acids,—

$$C_6H_4(COOH)(COCBr_3).$$

With NH_3 phthalyl-acetamide, $C_6H_4(CO)_2CH.CONH_2$, is formed. Concentrated H_2SO_4 gives rise to a compound crystallising in fine yellow needles, melting at over 300°,—



Sodium malonic ether forms two acids of the formula $C_{11}H_{10}O_4$, one of which is isatic, the other isatinbase. By the action of sodium acetate on phthalic anhydride and succinic acid the authors obtain a compound crystallising in yellow needles an inch long, soluble in aromatic liquids, to which they give the name ethin-diphthalyl,—

$$C_6H_4..(CO)_2..CH.CH..(CO)_2..C_6H_4.$$

Alkalies change it into a dibasic acid, phenylen-ethylen-keton-carbonic acid, and Br forms $C_{18}H_{10}Br_2O_4$.

P. G. W. Typke, "*Some Diazo-benzene Derivatives.*" The dioxy-azo-benzene of Baeyer and Jäger, prepared by mixing diazo-benzene nitrate and resorcin, is found to be a mixture of two isomeric bodies. A tribromo-derivative of the alpha compound was obtained by adding Br to the acetic acid solution. Methyl-dioxy-azo-benzene was obtained in a similar way from orcin. Its solutions, like those of dioxy-azo-benzene, are of a deep orange, and possess a notable tinctorial power. A dibromo-derivative was obtained. Diazo-benzene and alpha-naphthol yield an amorphous brown powder, $C_6H_5N_2N.C_{10}H_6(OH)$, azo-benzene-alpha-naphthol, which likewise possesses strong colouring properties. It yields no Br compound, but forms with H_2SO_4 a sulphonic acid, the solutions of which impart a brilliant orange-red to textile fabrics. It is probably identical with the acid alluded to by O. Witt above.

A. L. Thomsen, "*Mono- and Dimethyl-toluydins.*" The former is prepared from para-toluydin by the action of CH_3Cl, and subsequent distillation with acetic anhydride, as done by Prof. Hofmann in the case of mono-methyl-aniline (Chemical News, vol. xxxv., p. 141), and forms a yellow oil boiling at 208°. Nitroso- and dinitro-derivatives were prepared. Ortho- and para-dimethyl-toluydins were obtained from the corresponding trimethyl-toluyl-ammonium iodides by the action of Ag_2O and subsequent distillation; and form colourless oils, boiling respectively at 208° and 183°.

O. Landgrebe, "*Cyan-guanidins.*" The author obtains from ditolyl-guanidin a dicyano compound, $C_{15}H_{17}N_3.Cy_2$, analogous to dicyano-diphenyl-guanidin, which is changed by HCl into ditolyl-oxalyl-guanidin, $C_{17}H_{15}N_3O_3$, and in an alcoholic solution into ditolyl-parabanic acid. From aniline and dicyano-diphenyl-guanidin he obtains a dicyano-triphenyl-guanidin, identical with that prepared by Hofmann from the action of cyanogen on aniline as a by-product.

CORRESPONDENCE.

BORIC ACID.

To the Editor of the Chemical News.

Sir,—In a lately published work on chemistry, by Profs. Roscoe and Schorlemmer, under the head of "Boron Trioxide," the following passage occurs:—"Most metallic oxides dissolve in fused boron trioxide at a red heat, many of them imparting to the mass characteristic colours; hence this substance is much used in blowpipe analysis."

Now this statement seems merely the repetition of a mistake, transferred from one book on chemistry to another, to which I have been attempting in vain to call scientific attention for the last eight years. It is particularly referred to at page 275 of my published work, "Pyrology," under the head of "Cobalt," the oxide of which supplies an excellent illustration in point.

Most metallic oxides do *not* dissolve in boric acid before the blowpipe; do *not* impart colours to it; and, finally, it

is *not* much used in blowpipe analysis, except for that made upon my system, which (as regards boric acid) is grounded upon the non-solubility of almost all metallic oxides, added to a bead of that reagent before the blowpipe. In short, what the chemists have written of the behaviour before the blowpipe of metallic oxides in "boron trioxide" is true, not of it, but of *borax*, a very different substance.

I would appeal to any operator who has used boric acid in this manner for a confirmation (or contradiction of these remarks.—I am, &c.,

W. A. Ross.

ON THE MOTIONS OF CAMPHOR ON THE SURFACE OF WATER.

To the Editor of the Chemical News.

Sir,—I beg to thank Mr. P. Casamajor for his courtesy in sending me a copy of his paper on this subject, contained in the Chemical News (vol. xxxvi., p. 191). It has already been discussed several times in your pages, and I may especially refer to your volume for the latter half of 1863 for a number of details.

Mr. Casamajor's ingenious paper contains arguments in favour of a theory that has been more than once taken up and abandoned, while it neglects the real theory which has at various times given indications of its presence, until a few years ago it was completely established. This is by no means an unnatural result, considering that the phenomena in question have been discussed during upwards of a century and a half by some of the ablest physicists, until they have become so beset with theory that, like a rose in a deserted garden, the true theory has been smothered in the weeds of the false. As early as 1785 Lichtenberg noticed that on plunging a thermometer into the water on which the camphor fragments were rotating the motions suddenly ceased in consequence, as he sagaciously supposed, of some alteration in the surface, or the thermometer not being quite clean the surface became covered with a film.

Volta in 1787 referred the motions to an effluvium which escaped from the camphor explosively, after the manner of a firework, and produced motion by reaction. Prevost adopted this or a similar theory, and in his interesting controversy with the Italian physicist, Carradori, supported his view by much ingenious argument and experiment. In 1794, or even earlier than that, Carradori started his theory of surface attraction, *sull' attrazione di superficie*, on which, as he maintained, and on no other cause, the motions of camphor depend. Prevost replied with what he deemed a crucial experiment. If, he argued, these motions depend on the attraction of the surface, contact between the camphor and the surface of the water must be necessary; "but I can produce these motions," he said, "without any such contact." A bit of camphor on a raft placed on the surface of water will move about briskly, which proves, not that contact is necessary, but that the action of vapour at a distance is.

It is interesting now to sympathise with these two eminent men, who were both right in their respective views, seeing that the subject was not then ripe enough for reconciliation. Carradori replied by denying the possibility of such a result as that pointed out by Prevost, and I confess that in writing my History of this subject I was so impressed with Carradori's reasoning that I endeavoured to repeat Prevost's experiment with a strong prejudice against it—the very best preparation for failure that could possibly be adopted—and accordingly I failed. I tried a raft of tin-foil, and also one of cork; but some years later, when it became necessary that the experiment should succeed, I was led to suppose that the tin-foil was too heavy and the cork too thick for the production of a favourable result. In the *Philosophical Magazine* for December, 1869, I thus describe the result:—"I formed a raft of a small square of mica, placed on it a bit of camphor about the size of a small pea, took up the raft on the point of a penknife, and so launched it upon the surface of 6 ounces of water contained in a very clean cohesion-figure glass 3¼ inches in diameter. Before the raft had touched the water a visible shudder passed over its surface, showing the action of camphor at a distance. No sooner was the raft fairly launched than it began to sail about, and continued to do so with gradually slackening effort during a whole week. The advantage of using mica is that its surface is almost *à fleur d'eau*, and it sails about without allowing the camphor to be disturbed or to become wet."

In 1842-3 Dutrochet published a work in two parts, in which not only the motions of camphor, but a vast number of other interesting facts are traced to the influence of a force residing on the surface of liquids, and hence named *epipolii* (επιπολη, *surface*). This is, in fact, the attraction of superficies of Carradori, which seems to have been unknown to Dutrochet. The latter observer is by no means consistent with himself in the various sections of his work, nor does he seemed to have formed any very clear idea as to the nature of the force he was dealing with.

But the nature of the force that was to explain these camphor-motions had been, and was being, studied by a set of distinguished men without any special reference to the phenomena in question. The researches of Segner in 1751, and of Dr. Thomas Young, in 1806, rendered it very probable that there exists a contractile force or tension at the surface of liquids. The labours of Henry, Lamarle, Dupré de Rennes, Plateau, and others converted this probability into a certainty, so that the existence of such a force is not only capable of proof, but can also be expressed numerically for different liquids at a given temperature.

In 1862 Prof. Van der Mensbrugghe presented to the Royal Academy of Sciences of Belgium a memoir in which the motions of camphor and other bodies, liquid and solid, on the surface of water are accounted for on the principle of the surface-tension of liquids. It would occupy too much space in these columns were I to enter into details respecting this beautiful memoir, but I may refer to three papers of mine in the *Phil. Mag.* for December, 1869, January, 1870, and November, 1873, for a discussion of the various matters arising out of these phenomena and the new theory. There, too, Mr. Casamajor will find the electrical theory discussed, and some of the facts brought forward by him, accounted for in the surface-tension theory. For example, if a clean surface of water be very lightly dusted over with lycopodium contained in a muslin bag, and a bit of camphor or a greasy finger be dipped into the water the particles of dust will suddenly be repelled in a manner that is provokingly like electrical action.* But the fact is that we lower the surface-tension at the point touched, while the superior tension of the subjacent parts drags upon the weakened portion, and so produces the apparent repulsion. A bit of sponge tied to the end of a glass rod, and wetted with ether, held over the dusted surface is still more striking. Now, taking the surface-tension of water as = 7·3, and that of ether as = 1·88, it will be seen that there is a large residue of force in favour of the tension of water sufficient to account for the motions in question.

Mr. Casamajor will perhaps be so good as to reconsider his statement respecting evaporation as connected with the camphor motions. Let him try to repeat the experiment in a large clean stoppered bottle half full of clean water, but with the stopper in, and the experiment will fail. The fact is, that although the motions will continue

* A friend of mine, some years ago, informed me that having to visit a Swedish iron-forge for the purpose of making some chemical analyses, one of the engineers of the establishment puzzled everybody by producing the sudden repulsion of dust upon the surface of a water-tank by simply dipping his finger into it. No one else could produce the same effect, until my friend noticed that before producing it the experimenter always put his finger to his ear. My informant did the same: got out a little wax, smeared it over his finger, and then produced the same result. I may add, after having tried the experiment, that wax from the ear rotates on water after the manner of camphor

for days together in an open vessel exposed to the dust of the room, evaporation not only prevents the water from becoming saturated with camphor, but also maintains the tension of the surface sufficient for the production of these motions, which are due to the difference between the tension of water and that of the camphor solution at different points of the surface.—I am, &c.,

C. Tomlinson.

Highgate, N., Nov. 6, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 46, October, 1877.

Report presented by M. Lamy on behalf of the Committee of Chemical Arts on M. C. Vincent's paper, entitled "Products of the Distillation of the Vinasses of Beet-root.—One of the most abundant raw materials for the production of alcohol is the treacle resulting from the manufacture of beet-root sugar. When fermented and distilled it yields alcohol, and leaves as a residue a very aqueous brown liquid, known as "vinasse," containing the greater part of the non-volatile matter, organic as well as mineral, found in the saccharine juice of the beet. As early as 1837 Dubrunfaut showed that it was possible and advantageous to extract from it the salts of potash and soda present, and in this manner 2000 tons of alkaline salts are produced in France alone. The usual procedure is to concentrate the *vinasses*, evaporate to dryness, and calcine on the sole of a specially-constructed reverberatory furnace. M. Vincent's improvements consist in performing this operation in closed vessels, so as to utilise the volatile products. In this manner he collects ammoniacal liquor and tar. The former contains not merely salts of ammonia, but methylic alcohol, methylic sulphide and cyanide, salts of trimethylamin and of the principal fatty acids. The tar yields, among other products, phenol.

Report Presented by M. Cloëz on behalf of the Committee of the Chemical Arts on the Products of Vulcanised Caoutchouc from the Works of M. Eug. Turpin.—These products are artificial parchment, vegetable ivory, dentist's caoutchouc, and toys of the same material. The parchment serves as a substitute for the glazed papers, fine skins, gold-beater's skin, &c., used by perfumers, druggists, &c., to cover bottles, jars, &c. The vulcanisation is effected by the action of sulphur chloride dissolved in carbon bisulphide.

Nitro-glycerin, Dynamite, &c. (continuation).—M. Brull.—The author treats on the force of nitro-glycerin and the amount of heat liberated, and draws a comparison between gunpowder and nitro-glycerin. Nitro-glycerin heated suddenly to 180° explodes; if heated gradually to 193° it is decomposed, according to Champion, without ignition or detonation, but this assertion is contested. Neither the sparks of the Leyden jar, nor those of the induction-coil, nor currents of dynamic electricity cause it to explode.

Reimann's Färber Zeitung,
No. 35, 1877.

This issue contains nothing of general interest.

No. 36, 1877.

This issue is to a great extent taken up with the affairs the new Dyers' College at Berlin.

No. 37, 1877.

Artificial alizarin has fallen considerably in price, owing, it is said, to the prohibitive duty imposed on its importation into Russia.

MISCELLANEOUS.

The Institution of Civil Engineers.—In the Circulars announcing the commencement of another Session—the sixtieth year since its establishment—attention has again been directed to the importance of there being an unfailing supply, for reading at the weekly meetings, of Original Communications calculated to raise useful discussions. As an aid in this direction a list of subjects for papers has just been issued, prefaced by a statement of the funds at the disposal of the Council for rewarding the authors of meritorious communications. It has also been pointed out that it is equally essential that the "Minutes of Proceedings" should be made the depository of other original communications which from various circumstances are deemed better suited for publication alone than for reading and discussion at the meetings. The volumes likewise contain "Abstracts of Papers in Foreign Transactions and Periodicals," the aim in the latter case being to present a succinct *résumé* of the current engineering literature of all countries. The opening Meeting of the Session 1877-78 has been fixed for Tuesday, the 13th instant, when a "Review of the Progress of Steam Shipping during the last Quarter of a Century," by Mr. Alfred Holt, M. Inst. C.E., of Liverpool, will be read and discussed.

NOTES AND QUERIES.

Portland Cement (reply to A. P.).—Reliable in theory and practice: W. Michaelis, "Die Hydraulischen Mortel, Insbesondere der Portland Cement." Liepzig, 1869 (Quandt and Handel).—Manufacturer.

Portland Cement (reply to A. P.).—A. P. will find a good deal of valuable information on cements in "Reports and Awards," Group ii., Philadelphia Exhibition, from p. 147. May be had of Messrs. Lippincott and Co., Covent Garden.—John Cliff, Runcorn.

Crystals in Glass Manufacture, &c.—I am employed in a glass bottle works in this town, and under the microscope I find in any bad or devitrified glass we may make, a number of crystals of various shapes. Can any of your readers refer me to any book and diagrams which would teach me to recognise the different crystals? Also to any good books on glass which would be useful to a young man who has lately commenced the study of chemistry.—Tyro.

MEETINGS FOR THE WEEK.

Tuesday, Nov. 13th.—Civil Engineers, 8.

Wednesday, 14th.—Society of Public Analysts, 8. At Burlington House, Piccadilly, to consider and discuss a Report from the Council as to the working of the Sale of Food and Drugs Act, in order to enable a formal reply to be made to some inquiries by the representative of the German Government, who propose to introduce an Adulteration Act themselves. "On Milk Analysis," by J. Carter Bell, F.C.S. "On the Analyses of Five Mineral Waters," by Otto Hehner, F.C.S.

Thursday, 15th.—Chemical, 8. "On Gallium," by Prof. Odling. "First Report on the Chemical Society on some Points in Chemical Dynamics," by Dr. Wright and Mr. Luff. "On the Influence Exerted by Time and Mass in Certain Reactions in which Insoluble Salts are Produced," by M. M. P. Muir. "On Two New Fatty Acids of the Series $C_nH_{2n}O_2$," by C. T. Kingzett.

TO CORRESPONDENTS.

J. B. W.—We are not aware of any recent researches on the subject. Should we meet with anything we shall insert it in our columns.

Chemical Student.—Consult Church's or Johnson's works on the subject.

W. H. K.—Carbolic acid dissolves in water, the other oils do not. We gave the test you require in our report in 1866 to Her Majesty's Commissioners "On the Application of Disinfectants in Arresting the Spread of the Cattle Plague." This report is now out of print, but you will find it in the Chemical News, No. 340, vol. xiii., p. 270.

THE CHEMICAL NEWS.

VOL. XXXVI. No. 938.

ALUMINIUM PLATE AS A SUPPORT IN BLOWPIPE WORK.

By W. M. HUTCHINGS.

(Concluded from p. 210.)

I now give the list of sublimates, which anybody wishing to study should produce for himself. Where the pure metals themselves are used to produce them small pieces only should be taken, so that the size and appearance of the sublimate may be pretty much the same as what would be obtained from a mineral containing a fair amount of the metal in question. The least amount of heat and blast should be employed which will suffice in each case to produce a good distinct sublimate, which is always best when produced slowly. Too much heat or too strong blowing causes the fumes to be unnecessarily spread out. The mouth-blowpipe is best suited for this work, with a good taper nozzle and moderate bore, capable of giving a long, pure, blue flame,—not one of the blunt-ended monsters so generally seen in use in laboratories,—price about 6d.!

Arsenic.

(Fragments of *Niccolite* or *Smaltite* are better for observing this sublimate than native arsenic.)

When the quantity given off is not large the sublimate is white, and there is a black stain under the assay when it is heated directly on the plate. When much arsenic is present, and is given off rapidly (as when the assay is supported on a charcoal-slip), there is also a good deal of grey-black sublimate, and there are large black stains on the ledge.

In P.F.—The white portion is unaltered, but volatilises rapidly as the plate gets hot. The grey-black and black portions are somewhat whitened and partly removed, but dark stains remain.

In R.F. (blue tip).—The white is not darkened, but volatilises rapidly. The arsenic-smell is better noticed when substances are heated on the bare plate, or on the small charcoal-slip, than on the ordinary large pieces of charcoal.

Antimony.

The sublimate is pale yellow just in front of the assay, where it is thickest; further off it is pure white, shading off into bluish white film. It is much more compact and closer to the assay than when obtained on charcoal in the usual way. Most minerals containing antimony give off almost the whole of it while heated on the bare plate, before using charcoal-slip.

In P.F.—The white outer portion is unaltered. The yellow portion is more strongly yellow while heated, but pales again on cooling.

In R.F.—The white and yellow portions are *instantly* turned black by being touched with this; indeed the blackening takes place before the tip of the flame touches the plate at all. This is the best characteristic of the antimony sublimate, and is so sensitive that the faintest film gives a deep black circle wherever it is touched by the flame, enabling it to be recognised when only a very minute sublimate is obtained, or on the outer edges of mixed sublimates. There are several other metals whose sublimates darken in R.F., but there is nothing else which turns to black, and the only others which are affected so instantaneously are those of molybdenum and selenium, which can never be mistaken for antimony.

Stibnite and the various minerals containing antimony sulphide, unless heated very gently at first, give off a sublimate of unoxidised sulphide, dark yellow and yellowish red, which oxidises on further exposure to the flame.

Lead.

When a small piece of pure lead is heated directly upon the plate, it is only after long blowing, when the whole of the plate gets heated, that a small sublimate is obtained. Heated on a charcoal-slip a copious sublimate is at once formed. In front of the assay is first a narrow strip of pale yellow, which passes into orange, and this into a band of deep coffee-brown shading off into yellowish brown. Outside of all, and on the ledge, is a thin white sublimate. The yellow and orange are small in amount compared with the coffee-brown, which is the largest portion of the sublimate. (See *Bismuth.*)

In P.F.—The pale yellow and the orange are rapidly turned deep brown, like the darkest portion of the original sublimate. The outer white is also strongly browned, even where only a thin film of it is present, though not so deeply as the rest. All the portions of the sublimate retain the brown colour completely on cooling. (See *Bismuth.*)

In R.F.—All the portions of the sublimate turn almost black, but the reduced parts have a very different appearance from, and take much longer to form than, those of antimony.

Lead with Antimony.

The detection of antimony in lead, even if present in very small amount, is much more easy and certain on aluminium than on charcoal in the ordinary way. By heating the lead directly on the ledge, the antimony is obtained practically free from lead, which, as above mentioned, can only with difficulty be made to give any sublimate on the bare plate. If very little antimony indeed is contained, the bit of lead is best placed on the plate together with a bit of fused boric acid about half its size, and the two heated very strongly. Nothing at all will be obtained for some time, but, as the heat of the plate increases, a small, pure, white antimony sublimate will form slowly. The boric acid serves the double purpose of holding the little ball of lead from rolling or being blown away, and of taking up what little oxide of lead is formed. It is in cases like this that the superiority of aluminium is most apparent; an amount of antimony that would be completely dissipated on ordinary charcoal is here condensed into a small compact sublimate; and when so little is present as to give only a barely distinguishable film, it is proved to be antimony by its instant blackening in R.F.

Bournonite, Boulangerite, &c., treated on the bare ledge, give off almost all the antimony without any lead; afterwards, on the charcoal-slip, a sublimate of lead with little antimony; and finally a pure lead sublimate can be obtained.

Bismuth.

For the bare plate the same remarks apply as to lead. Obtained from the charcoal-slip the sublimate, like lead, is yellow nearest the assay, passing into orange, and this into brown. The yellow is darker than with lead, and the yellow and orange are much more extensive than the brown (reverse of what is obtained with lead); also this brown is not nearly so dark as that of lead, and has quite a different appearance. Outside of all, and on the ledge, is a good deal of pale yellow sublimate.

In P.F.—The yellow and orange darken in colour, but nothing like as much as the lead sublimate, and the greater part of the darkening disappears on cooling. This is a very characteristic difference between lead and bismuth.

In R.F.—Same as lead.

On charcoal, in the ordinary way, the lead and bismuth sublimates are so much alike that they can hardly be distinguished. It will be seen that on aluminium there are sufficient differences to render the distinction much more easy. If a little bismuth is suspected in a lead sublimate, a small quantity should be scraped off, and examined by

the test with "microcosmic salt" and tin. This test may always safely be used in the absence of antimony, because, although lead oxide will produce the same darkening of the bead, still so much of it is required to produce the same effect as that of a very minute quantity of bismuth oxide that there is no danger of mistake if only a small amount of the sublimate is dissolved. This is easily proved, and the limit as to quantity of sublimate which may safely be dissolved is ascertained by a few experiments with pure lead sublimate, and with one containing a little bismuth.

Von Kobell's beautiful test for bismuth, by use of potassium iodide and sulphur, acts splendidly on the aluminium plate, either on the bare ledge or charcoal-slip. The red sublimate forms nearer the assay than on ordinary charcoal. Much lead obscures the reaction, rendering the bead-test necessary.

Cadmium.

A dark brown, almost black, sublimate, which is not altered by P.F. or R.F.

A little reddish brown sublimate is mostly seen on the edges of the charcoal-slip.

Zinc.

It is scarcely possible to obtain any sublimate at all when a bit of pure zinc is heated on the bare ledge. Heated on the charcoal-slip, a bit of metal, at the moment when it takes fire, gives an almost black sublimate on the plate. This black sublimate is not obtained when zinc minerals are treated. After this the sublimate of zinc oxide forms, and is just the same as on ordinary charcoal —yellow hot, and white cold. In P.F. and R.F. unaltered. The greater portion encrusts the charcoal-slip just round the assay, and is tested with cobalt solution.

Tin.

On bare plate, same as zinc.

On charcoal-slip the greater portion of the sublimate is close to the assay, on the charcoal, and is tested with cobalt solution. A small white sublimate forms on the plate, very slowly.

In P.F.—Unaltered.

In R.F.—Is darkened very slowly, and not very much.

Molybdenum.

This sublimate is best produced either from a bit of the native sulphide, or from a bit of ammonium molybdate the size of a large pin-head, laid on the bare ledge, and heated a long way from the tip of a strong flame. It is pale yellow where thickest, and white farther off.

In P.F. it is yellower while hot; pales again on cooling.

In R.F.—An instant contact, such as passing the sublimate very rapidly through the flame, produces the same splendid blue colour as on the ordinary charcoal, only that it has even a more beautiful colour on the aluminium. If the sublimate is slowly brought up from some distance towards the flame, it will be seen to turn blue when still a good way from the blue tip, being rather more sensitive than antimony. As it is much more concentrated on aluminium, and the blue obtained from the slightest film is much better seen than on charcoal, a smaller amount could be detected.

The further reduction of the blue to copper-red cannot be obtained on aluminium as it can on charcoal.

Thallium.

A small piece of the metal, heated very gently on charcoal-slip, gives at first a copious white sublimate, which spreads far to the sides and up the plate. After a few moments, as the heat of the slip increases, a dark sublimate is also given off, which is not so much spread out. It is strong reddish brown where thickest, passing off through lighter shades into the outer white.

In P.F.—The white portion *instantly* turns reddish brown, and this takes place best fully 2 inches in front of the tip. This is very characteristic: the browning of the lead sublimate is not nearly so rapid, and the colour produced is very different.

In R.F.—Both the original brown sublimate and that produced from the white give black metallic stains, and, where thickest, little black balls can be seen with a lens.

Selenium.

Substances containing selenium are characterised by the peculiar "horse-radish" smell given off on heating, especially on charcoal-slip; and by the red or copper-coloured sublimate obtained, both on the bare plate and on the charcoal-slip. There is also some brown and white sublimate produced.

In P.F.—The red and brown portions are whitened over.

In R.F.—All the parts turn a rich dark velvety brown. The action is almost as instantaneous as in the case of antimony, but the colour is very different, and with the other special characteristics of selenium there is no danger of their ever being mistaken.

Clausthalite (from Tilkerode) on the bare ledge gives a sublimate of selenium without any lead. On charcoal-slip, gently heated, more selenium sublimate comes off, almost free from lead, and finally the lead sublimate.

Silver.

A good-sized piece of pure silver, placed on a charcoal-slip, rapidly gives a large sublimate on the plate. It is brown in the centre, shading off into a lighter rim having a reddish tinge; and down below, where the glowing edge of the charcoal-slip has been close to it, is a narrow slip, almost white, with faint pink tinge.

In P.F.—This strip and the lighter-coloured rim darken, and the entire sublimate is turned a much darker brown.

In R.F.—A circle of white is produced by contact with the blue tip, looking very much like "frosted silver." It is produced very rapidly on any part of the sublimate. The dark brown is at once reproduced by exposing again to P.F. In addition to the silver carried over as sublimate, little balls and splashes of metal are seen, under the lens, which are thrown out by the occasional "spitting" of the fused ball of silver.

This sublimate from metallic silver, though interesting as showing the great ease with which silver is volatilised by heat and blast, is not of use as a test. The beautiful rose-coloured sublimate produced when silver is volatilised with lead or antimony, or both together, is, according to Plattner, a certain indication of the presence of silver in a mineral from which it is obtained. The colour from silver and antimony, on aluminium, is similar to that on charcoal, but it comes out better and is produced earlier on in the process.

Owing to the colour of most of the lead sublimate being so much darker on aluminium than on charcoal, the rose-colour is only obtained with lead and silver on the outer edges. Where these begin to pass over into the brown, the rose gets changed into a darker purple-red tint, and is soon lost in the deep coffee-brown, so that lead is not as well suited on aluminium for the observation of the rose sublimate as on charcoal, though it is always easily recognised. Ross believes that in this rose sublimate we have a delicate and valuable test for silver in ores, a little of the powder of which is to be heated on a charcoal-slip with a little assay-lead free from more than traces of silver. I have made many trials by heating various samples of ore, of very varying composition and richness, with addition of lead, and lead with antimony, but I do not find the test of much value. In some cases of rather poor ores a distinct rosy colour was obtained, while in others of great richness (for commercial samples) no sign of it was seen; these differences being apparently caused by the action of other constituents of the ore. Quartz and silicates, for instance, in any considerable amount, seemed to render it impossible to obtain this sublimate.

There is no doubt that the sublimate from a ball of pure silver is metallic only; but this is by no means so certain

in the case of the rosy sublimate. It is very probable that, in company with lead and antimony, some, at least, of the silver is volatilised as oxide.

Gold.

I believe Major Ross was the first to give gold among the metals whose sublimates can be obtained with the common blowpipe, which is owing to the fact that it can be easily produced and seen on aluminium, though not on ordinary charcoal. No doubt it could be observed on the porcelain supports. Ross appears to have produced it only from a ball of gold and lead, as he makes no mention of getting it from pure gold. In his book is a coloured representation of a very beautiful sublimate obtained from gold with a little lead; and it appears that he regards the lead as necessary for the operation, attributing the colours to *oxide* of gold, formed and volatilised by the action on the gold of the lead oxide produced. But I find that a very fine gold sublimate can be obtained in two or three minutes by strongly heating a little ball of perfectly pure gold on a charcoal-slip on the ledge.* The mouth-blowpipe suffices, but it is got more quickly, and better, by using a stand-blowpipe and hand-blower. After two minutes' blowing the appearance on the plate was as follows:—Nearest the charcoal, where the heat on the plate had been greatest, was a small arch of pale yellow colour—just a thin film of gilding over the aluminium. Beyond this was a strip, $\frac{1}{4}$ to $\frac{1}{2}$ inch wide, of a beautiful violet or purplish violet colour; and dotted all over the sublimate were little specks and splashes of gold carried over mechanically. By heating for a much longer time, with frequent stopping to let the plate cool, very fine sublimates may be produced. The sublimate with lead, described by Ross, seems to me to be simply that of metallic gold placed over that of lead oxide. It takes much longer to produce, and does not seem to be appreciably formed till all the lead is driven off. The purplish violet obtained is clearly the same as the deposit on white paper held under a fine gold wire through which a powerful electric discharge passes; and it is certainly interesting to be able to obtain the same appearance by means of the blowpipe.

In connection with this gold sublimate is a very pretty little experiment, first stated, I believe, by Ross, to which was as it is very interesting and not much known—I should like to allude, although it does not form any part of the subject of these notes. He found that if a bead of phosphoric acid is made on platinum wire (by taking up and gradually heating successive small fragments of pure glacial acid) it will easily, in O.F., dissolve gold-leaf. If then held a little while about an inch from the tip of the flame, it will on cooling take a beautiful bluish violet tint. If very little gold is dissolved, a faint tinge, or perhaps streaks only, of a fine pink will be obtained. I find that by varying the quantity of gold dissolved various shades of pink, ruby, violet, purple, green-blue, and finally a splendid blue, may be produced. On heating again the colour rapidly disappears, the bead being yellow hot, and taking the colours again on cooling. This disappearance and re-appearance may be repeated any number of times, only that the colour is seldom twice running the same. A bead will cool once a deep blue, and perhaps next time a pink or violet. It succeeds best in a good large bead, so that phosphoric acid should be added from time to time to replace what is volatilised. If the hot pale yellow bead is cooled suddenly no colour appears; but it can then be produced by very gently heating (so that the bead is just softened) a good way from the tip of a very small flame. Ross believes the colour to be caused by an oxide of gold, but it seems as if it were produced in the same manner as the colours of the rose-red and ruby glass made on the large scale by means of gold, and which are considered to depend upon a separation in the glass of finely-divided metallic gold. The metal is doubtless dissolved to a phosphate which has a pale yellow colour in the bead; but on cooling slowly, or gently annealing, the glass cannot retain the gold in solution, and so it separates out more or less, giving a colour according to the quantity liberated.

I find that "microcosmic salt" dissolves gold-leaf as rapidly and as easily as does phosphoric acid, giving the same yellow colour hot, and taking even more beautiful colours in cooling, though it is more capricious than phosphoric acid, and frequently cools quite colourless, even when a large quantity of gold is dissolved. When this takes place with a large bead any shade of the colours may be produced by very gently heating the bead as above—from the faintest pink at the beginning to a deep blue at the end. At one stage a magnificent ruby is got, at another the same colour as the gold sublimate on aluminium, and at another bluish green. All the beads appear perfectly transparent.

I do not find this easy solubility of gold in phosphoric acid or in sodium phosphate mentioned anywhere but in Ross's book, and he appears only to have observed it with the acid.

I find gold-leaf is also dissolved in borax, though not so easily as above. When a good deal is dissolved the bead has the same yellow colour hot, and cools to a very faint green-blue tinge. None of the above colours can be got either during cooling or by annealing; indeed if a little borax is added to a bead of "microcosmic salt" which has a large quantity of gold in it, and which is capable of giving the deepest colours, this property is at once destroyed, the bead being then just like a borax bead, and no colour being obtainable. Gold-leaf is of course best for these experiments, because it dissolves most rapidly; but even from a little ball of gold, held in the centre of the loop and kept clear of the wire, sufficient gold is taken into solution in a few minutes to give the deep blue.

These little experiments are so pretty and interesting that I hope I need not apologise for taking space to allude to them for the benefit of those to whom they are unknown.

* Care must be taken not to let the ball of gold fall off the charcoal-slip on to the plate, as, if this takes place after the plate has got hot, the molten gold eats a hole in it. This is the only case in which I have found any damage done to the aluminium.

ERRATA.—Page 209, column 1, line 14 from top, *for* "just" *read* "first." Page 209, column 2, line 7 from bottom, *for* "paste" *read* "plate."

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 208.)

Phosphorus and Matches. By Dr. ANTON VON SCHRÖTTER Master of the Imperial Mint at Vienna.

THE reporter at an early date had proved by his researches on the remarkable behaviour of amorphous phosphorus with chlorate of potash and other bodies rich in oxygen that, with phosphorus in this modification, mixtures of every degree of combustibility might be prepared. Among the matches which were experimentally prepared with such mixtures there were always a few which satisfied every requirement. Though the technical problem was thus by no means solved these experiments had at least proved the possibility of such a solution. To M. Hochstätter belongs the merit of having discovered the conditions for the industrial preparation with amorphous phosphorus of matches capable of superseding those containing the ordinary quality of phosphorus, even in the opinion of a prejudiced public, and which were capable of ignition on any at all suitable surface. The Hochstätter

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

matches, indeed, leave nothing more to be wished for. They can be struck even upon cloth; they burn quietly, without noise or spirting, almost without smoke and smell, and very rarely fail, as the reporter has convinced himself by a prolonged trial.

These matches attract absolutely no moisture, and can therefore be used on shipboard and in all climates. What is still more important the workmen during their production are not exposed to danger of any kind soever; nor can they give rise to poisoning, intentional or accidental. They are also cheaper than the ordinary kind, since the mixture costs:—For those with sulphur, 0·8 shilling; for those without sulphur, 1·7 shilling; for wax-tapers, 1·42 to 2·0 shillings; whilst it is stated that in Germany the mixtures for the same number of ordinary matches cost respectively 1 shilling, 2 shillings, and 2·8 shillings.

The manufacture of these matches is without doubt the greatest improvement which has been effected in this trade since 1862, and the question now arises in how far it has become the serious duty of governments to listen to the many and important voices which for years, though unfortunately in vain, have urged the banishment of ordinary phosphorus from the match trade. Half measures—such as improved ventilation in factories, and the prohibition of glue in the composition of the mixture, because in that case it must be used hot—remove the evil only partially, or not at all. An attempt has been made to lessen the danger to which the workmen are exposed by reducing the proportion of phosphorus to a minimum. How ineffectual such endeavours have hitherto been appears from the circumstance that in some works even yet mixtures are employed with a proportion of phosphorus far exceeding the 6 or 7 per cent which in Austria is found amply sufficient.

Dr. Letheby proposed the use of oil of turpentine for the absorption of the vapours of phosphorus, and in the works of Black and Bell, at Stratford, near London, and more recently in several German establishments, each workman wears on his breast a vessel containing this oil. But this suggestion has by no means removed the pernicious effects of the vapour of phosphorus, since absorption still takes place through the skin and the clothing. It is also still an open question whether the vapours of phosphorus are rendered harmless by oil of turpentine, or if their smell is merely disguised. Such palliatives are often hurtful instead of useful. Those concerned allow themselves to be lulled into a feeling of security whilst the danger is still present.*

When governments find it necessary to interfere in technical arrangements great caution is doubtless requisite, since an ill-timed regulation may increase certain evils instead of diminishing them. The question, however, now a perfect method of employing amorphous phosphorus in the manufacture of matches has been discovered, seems analogous to that of the poisonous Schweinfurt green, which governments who care for the physical well-being of their citizens did not hesitate to prohibit when once a complete substitute had been found in the shape of the new chrome green. Moreover, the opposition of manufacturers to the introduction of amorphous in place of ordinary phosphorus would not be very violent, since in an establishment which employs the common kind of phosphorus little alteration of plant would be needful.

Ordinary phosphorus can lay claim neither to economy, nor to a superior quality of the article produced, nor to greater convenience in the manufacture. On the contrary, quite independent of its absolute innocence in all these points, the amorphous modification has the advantage. In laying out new works there is further no occasion for costly and especial arrangements for ventilation, and for abnormally lofty work-rooms if the amorphous phosphorus is to be used.

The *Compagnie générale des Allumettes Chimiques*, which, by a recent French law, has obtained a monopoly of the match trade, will, it is to be hoped, not fail to set in this respect a good example, as on account of the concentration of the whole manufacture it would be easy for it to work this improved process to advantage.

As to the composition of the mixture used in Sweden for so-called safety-matches which ignite only on a prepared surface there prevails still some uncertainty, and it is possible that the formulæ used in different manufactories are not absolutely identical. According to Jettel, whose statement is based upon an analysis of the mixture performed by Kriwanek in the laboratory of Prof. Hlasiwetz, but has been slightly modified for actual use, its composition is the following: –

Glass	1¼ part.
Glue	1 ,,
Bichromate potash	¼ ,,
Chlorate potash	6¾ parts.
Oxide of iron	½ part.
Black oxide of manganese	2 parts.
Sulphur	1 part.

According to Jettel the quantity of sulphur is given too high, the cause of which may possibly be that the matches were not genuine Swedish. Jettel considers that it should not exceed the half of the proportion as given above.

The composition of the friction-surface is:—

Glue	1½ part.
Umber	1 ,,
Manganese	4½ parts.
Sulphuret of antimony	16¾ ,,
Amorphous phosphorus	10 ,,

Gentele has subsequently examined the composition of Swedish matches, and obtained very different results. He found: –

Chlorate of potash	32 parts.
Bichromate of potash	12 ,,
Red lead	32 ,,
Sulphuret of antimony	24 ,,

This mixture ignited readily upon a surface consisting of 8 parts of amorphous phosphorus with 9 parts of sulphuret of antimony.*

It appears from the experiments of Gentele that slight differences in the composition of the mixtures have little effect upon the quality of the matches, if only the preparation has been careful, *i.e.*, if the separate ingredients have been ground as finely as possible, and intimately mixed, which applies also to phosphorus matches and to all similar mixtures. The selection and preparation of the wood are not a matter of indifference.

The endeavours to produce matches entirely free from phosphorus have continued without interruption since the investigations of Wiederhold,† which are of permanent value, and must be regarded as the basis of all subsequent enterprise in this direction. In the opinion of many they have not yet been so far improved as to be on an equality with phosphorus matches. They are still too hard to strike, diffuse an unpleasant odour, and have no advantage in cheapness. The non-phosphoric matches, however, recently produced on the large scale by G. Kalliwoda‡ are said to be totally or almost entirely free from these defects. This important problem may therefore be regarded as solved if prolonged experience confirms the above favorable reports.

According to C. Liebig a good mixture, free from phosphorus, may be prepared as follows:—

Sulphuret of antimony	8 parts.
Chlorate of potash	16 ,,
Red lead	10 ,,
Bichromate of potash	1 ,,
Nitro-mannite	8 ,,
Glass	4 ,,
Gum arabic	5 ,,

* Gentele, *Pharm. Zeit. Russland*, 1871, 361.

† Wiederhold, *Jahresber. f. Thermol.*, 1861, 622.

‡ Kalliwoda, *Deutsche Industrie Z.*, 1871, 17.

* See W. Jettel, "Die Zündwaaren und Explosionen in ihren Gegenwärtigen Ausbildungen." Brunswick: F. Vieweg & Son, 1871.

Particulars as to the value of this mass are unknown; it cannot be cheap and the preparation may not be free from danger.

Among the non-phosphoric mixtures must be included that suggested by Fleck, containing finely divided sodium diffused in paraffin.

As ingenious as are the methods proposed to counteract the unfavourable attributes of the sodium, this proposal will in all probability never be practically realised, especially as better agents are known.

For blasting charges under water Fleck's mixture might possibly be applicable, but the spontaneous decomposition which gradually sets in would be found a difficulty. E. Kopp* has already called attention to its disadvantages, whilst Springmühl, after a careful examination, and also Jettel, deny that it possesses any practical value.

At the Exhibition France, Sweden, and Austria represented the match trade.

On behalf of France appeared the *Compagnie Générale des Allumettes Chimique*, formed in the month of October, 1872, and possessing the legal monopoly for the production of matches in the whole of France. For this privilege it pays to the Government a fixed tax of 16,000,000 francs as long as the consumption in France does not exceed 40 milliards. Beyond this consumption there is a progressive duty of 6 centimes per 100 matches. Hence this company alone represents the whole of the match trade of France. The former manufacturers, in expectation of the expropriation which they had daily to await, did not exhibit. The importance of this manufacture for France appears from the following figures.

The number of the (former) match-works in France, large and small, amounts to no fewer than 833. The inland consumption is on the average five matches daily per head, or 70 milliards yearly. The company must, therefore, meet the enormous daily demand of 180 millions without maintaining the old 833 works in activity. It has, therefore, decided to concentrate the production in twelve establishments, which will be distributed in the country according to the need of production and the convenience for procuring the necessary materials. It is of opinion that it will be possible to introduce into each of these works all those improvements, industrial and sanitary, which science has pointed out as requisite.

Of the 180 millions of matches daily required 150 millions are of wood and 30 millions of wax. The former require yearly 45,000 cubic metres of wood (oak, poplar, aspen, pine, and birch), 1200 to 1500 tons of roll-sulphur, and 300 tons of phosphorus (1 ton = 1000 kilos.). The 30 millions of wax-matches represent a yearly consumption of—

300,000 kilos. spun cotton.
300,000 kilos. stearin.
60 tons of phosphorus.

To this must be added the consumption of the other articles, such as red-lead, gum, &c., of which the company's report to the jury gives no account.

This daily production of 180 million matches requires above 6000 workpeople, both men and women. The varied, more or less elegant, pasteboard boxes are manufactured by the company, 3 millions being required daily, requiring a yearly consumption of at least 2500 tons of pasteboard of various qualities. As to the number of workpeople engaged in the production of these boxes the report gives no particulars, but we may conclude from other sources that about 12,000 persons of both sexes will suffice, to whom must further be added those employed in packing and sending off, to the number of at least 200 persons.

The above figures refer merely to the home consumption, but there is also a considerable exportation, not merely by sea, but even into other countries of Europe. The French marks, "Roche," "Causemille," "Meiffreu," are in request at La Plata, Buenos Ayres, Japan, Guatemala, Peru, &c. The exportation amounts to the yearly value of 15 mill. francs, and consists exclusively of wax-lights and round wooden matches. The traffic of the Société Générale is therefore as follows:

Domestic consumption ..	65,000,000	frs.
Exportation	15,000,000	,,
	80,000,000	,,

Which is distributed as follows:—

Duty on consumption ..	35,000,000	frs.
Duty on exportation	1,800,000	,,
Allowance to dealers	13,000,000	,,
Cost of production and profit	30.200,000	,,
	80,000,000	,,

Finally, must be remarked that in the show-case of the company Coignet, Père et Fils, exhibit matches with a friction-surface of amorphous phosphorus.

In few countries has the manufacture of matches reached such a development, and is still making such progress, as in Sweden. Swedish matches are known in all civilised countries, and so valued that counterfeits are sold as Swedish. The exportation, which was only 1,114,677 kilos. in 1865, and 2,896,398 kilos. in 1870, rose in 1871 to 4,281,395, and in 1872 to 6,059,601 kilos. The requisite chemicals are imported from England. The works at Jönköping alone produce yearly matches of the value of 1¼ million riksdaler (at 1 mark 14 pf. German), and the production of the remaining twenty-four establishments now in operation may be of equal value. Besides, there are some manufactories engaged solely with the manufacture of fusee-wire.

The largest establishment at Jönköping is the property of a joint-stock company. It was founded in 1845, and is driven by four steam-engines of the joint power of 76 horses. In 1872 there were employed 255 men, 849 women, 105 boys, and 141 girls, the two latter groups under eighteen years of age; together, therefore, 1350 persons. Of the workwomen, 668 were only periodically engaged in their own houses, and that with the manufacture of boxes.

The production is constantly increasing, and amounted in 1872 to 128,039,754 matches of different kinds, representing a value of 1,857,249 riksdaler. About four-fifths of the total production are exported. The company has founded a school, a reading-room, baths for the workpeople, and is now erecting cottages for their accommodation. It employs alone as many workpeople as all the rest of the Swedish match works, and paid in 1872 360,514 riksdaler in wages.

(To be continued.)

* Kopp, *Monit. Scientif.*, 1870, 74.

ACTION OF ANHYDROUS ACIDS UPON ANHYDROUS BASES.

By M. J. BECHAMP.

It is still a question if the anhydrous acids, which certain modern chemists call anhydrides in order to deny altogether their acid function, are or are not acids. If we demonstrate that anhydrous acids, of whatever nature, are capable of uniting entirely with anhydrous bases, differing also in their nature, the theory of Lavoisier will receive a signal confirmation.

I. *Action of the Anhydrous Mineral Acids upon Anhydrous Mineral Bases.*

M. Bussy has already shown that sulphate of baryta may be formed by bringing in contact anhydrous sulphuric acid and anhydrous baryta. Borate of lime may even be formed by projecting anhydrous lime into anhydrous boric acid in a state of tranquil fusion. The combination is accompanied with the evolution of heat and light.

II. *Action of Anhydrous Organic Acids upon Anhydrous Mineral Bases.*

The author has caused anhydrous acetic, butyric, and caproic acids to act upon anhydrous oxides of calcium, barium, lead, and mercury.

Action of Anhydrous Acetic Acid upon Anhydrous Lime.—The base mixed with an excess of absolutely pure acid is introduced into a green-glass tube: a thermometer is plunged in the mixture, and the tube is then sealed over the lamp. It is then heated to 133° in a bath for four hours. The internal temperature of the tube rises to 141°, and remains there for about twenty minutes. The mass increases in volume, and the lime is *slacked* in the anhydrous acid. The product, freed from excess of acid, and dissolved in water, crystallises like acetate of lime, and has its composition. Anhydrous acetic acid combines directly with anhydrous baryta at 100°. Anhydrous butyric and caproic acids combine directly with anhydrous lime at 120°. The quantity of the salts obtained, as calculated from the weight of lime employed, is almost theoretic. Anhydrous acetic acid unites completely with perfectly dry oxides of lead and mercury. The salts obtained, which are almost theoretic in quantity, when freed from excess of acid dissolve in water, and crystallise with their peculiar characters. In the experiment with oxide of mercury the temperature of 105° must not be exceeded. In an instance where this was done the substance was blackened, and the tube burst on being opened. This fact will be considered on a future occasion.

III. *Action of Anhydrous Mineral Acids upon Anhydrous Oxides of Organic Radicals.*

The author has not experimented upon this particular case, affirmative instances being already known. MM. Dumas and Peligot obtained sulphate of methyl by the direct action of anhydrous sulphuric acid upon oxide of methyl. M. Wetherill produced sulphate of ethyl by passing the vapour of anhydrous sulphuric acid into anhydrous ether.

IV. *Action of Anhydrous Organic Acids upon the Anhydrous Oxides of Organic Radicals.*

These combinations are obtained with difficulty, and the action of prolonged heat is required. M. Wurtz has combined directly oxide of ethylen with anhydrous acetic acid, obtaining ethylenic acetate and propyl-ethylenic acetates. The author has combined directly anhydrous butyric and acetic acids with anhydrous oxide of ethyl. The ethers obtained have the same characters and the same boiling-point as those obtained by the ordinary methods.

TEST FOR SANTONIN.

By DAVID LINDO.

To the powerful agency of sulphuric acid we are indebted for many of the finest colour-tests in chemistry. I refer to those tests employed for the identification of certain organic substances, which are first dissolved in concentrated sulphuric acid, and other agents applied to them afterwards.

I have lately endeavoured to discover tests for some organic compounds for which at present very few or no characteristic reactions are known. If the substance will dissolve in sulphuric acid without charring, I always try the effect of different agents on this solution. It was in seeking a test for carbolic acid by this method that I met with the reaction previously published, and which I have proposed also as a test for nitric acid.

I have since been occupied with santonin. So far as I have been able to ascertain we possess no characteristic tests for this substance. As it is extensively employed out here, and I have no doubt in other places also, and as large doses are said to produce symptoms of irritant poisoning, a good test for it might prove acceptable.

I experienced great difficulty with this substance for a long time. Its almost neutral chemical properties, and the facility with which it decomposes into products of a dark brown colour, rendered it very unmanageable. At last I fell upon a reaction which seems to be fairly sensitive; it appears also to be very characteristic. The following is the test, and method of applying it:—

Place the santonin in a small deep porcelain dish, and dissolve it (without heat) in concentrated sulphuric acid. Rubbing the crystals down with a glass rod greatly facilitates solution. Add highly dilute solution of perchloride in small quantities at a time, and between each addition give the dish a pretty quick rotatory motion while it is supported on a table. A fine red colour is first developed, which changes to a magnificent purple, and then to a splendid violet as the sulphuric acid becomes more dilute. The heat produced by mixing the fluids is necessary to develope the colours.

When applying the test to small quantities of santonin a somewhat different method of proceeding must be adopted. The experiment in this case is best performed in a 1-inch shallow porcelain capsule, with a thick flat bottom. Mix the highly dilute solution of perchloride of iron with an equal bulk of concentrated sulphuric acid, and add the mixture to the santonin. Heat must then be cautiously applied. The crystals of santonin will slowly dissolve, and the colour will be developed.

The capsule is conveniently supported on the blade of a spatula, and heated by a spirit-lamp.

One drop of a solution of 1 grain of santonin in 1 fluid ounce of chloroform was evaporated to dryness in a small capsule, and the residue heated with a drop of the perchloride of iron and sulphuric acid mixture. A very fine reaction was obtained.

The separation of santonin, however, from other organic matters would in most cases be a very difficult—and in many instances an impossible—thing to accomplish, owing to the facility with which it suffers decomposition.

In trying the experiment of separating santonin, by means of chloroform, from a powder containing rhubarb and santonin, I noticed a thing which I have not seen mentioned before. The chloroform separated from the powder by filtration was evaporated to dryness, and the residue tested for santonin. The violet colour was obtained very distinctly. I then tried the effect of the test-fluid on the colouring-matter of rhubarb alone, as I noticed this is dissolved by chloroform. The test produced a reddish colour, not the violet or purple colour of santonin.

Thinking that in the case of rhubarb the iron had nothing to do with the reaction, I next tried the effect of *concentrated sulphuric acid alone* on the colouring-matter of rhubarb. I found it produced a beautiful scarlet colour: this is much the same effect (as is very well known) produced by alkalies on the colouring-matter; and when the latter has been turned red by an alkali an acid restores it to yellow.

Falmouth, Jamaica,
October 6, 1877.

PROCEEDINGS OF SOCIETIES.

AKADEMIE DER WISSENSCHAFTEN, VIENNA.

July, 1877.

G. GOLDSCHMIDT, "*Idryl.*" This body, found by Bödeker in Idria, is ascertained to consist of several hydrocarbons, which are separated from each other in the form of picrates. Besides chrysen, pyren, anthracen, phenanthren, a new hydrocarbon, $C_{15}H_{10}$, was isolated, and receives the name originally applied to the mixture.

G. CIAMICIAN, "*Distillation of Resins and Resinous Acids with Zinc Dust.*" Aromatic bodies exclusively result from the experiments. Abietic acid and colophony both yield toluen, ethyl-methyl-benzen, naphthalen, methyl-naphthalen, and methyl-anthracen. Gum-benzoin gives rise chiefly to toluen, accompanied by small amounts of xylen, naphthalen, and methyl-naphthalen.

E. v. SOMMARUGA obtains by the "*Action of Ammonia on Isatine*" under pressure, isatine-diamide, $C_{16}H_{12}N_4O_2$, oxy-di-imido-diamido-isatine, $C_{16}H_{14}N_6O_3$, and desoxy-imido-isatine, $C_{16}H_{11}N_3O_2$. These compounds render it probable that the molecular formula of indigo, C_8H_5NO, should be doubled.

H. SKRAUP gives for the "*Formula of Cinchonin*" $C_{19}H_{22}N_2O$, as formerly asserted by Laurent, instead of the present one, $C_{20}H_{24}N_2O$, on the ground of a large variety of analyses of the carefully purified base and its salts. The amount of $KMnO_4$ requisite for oxidation to cinchotenin and formic acid,—

$$C_{19}H_{22}N_2O + O_4 = C_{18}H_{20}N_2O_3 + CH_2O_2,$$

corresponds likewise to this formula. A base, $C_{19}H_{24}N_2O$, was separated from the more soluble part of commercial cinchonin, and is evidently hydro-cinchonin.

G. NIEDERIST, "*Action of Water on the Halogen Compounds of the Alcohol Radicals.*" By heating with an excess of H_2O at 100° the author easily changes these compounds into the corresponding alcohols, methyl-iodide into methyl-alcohol, allyl-iodide into allyl-alcohol, ethylen-bromide into ethylen-glycol, &c.

L. HAITINGER obtained by the "*Action of* HNO_3 *on Trimethyl-carbinol*," nitro-butylen, $C_4H_7NO_2$, which forms a sodium compound, $C_4H_6NaNO_2$, of an explosive character.

A. LIEBEN and S. ZEISEL, "*Action of Saline Solutions on Aldehyds.*" Propionaldehyd yields a condensation product, $C_6H_{10}O$, possessing the characteristics of an aldehyd, boiling at 137°, and forming an acid by oxidation.

G. CIAMICIAN, in a study on the "*Spectra of the Chemical Elements and their Compounds*," comes to the same conclusion as Lockyer, that the spectra of compounds, as well as those of the first order of elements, consist exclusively of bands; and, further, that the bands belong to molecules and the lines to free atoms. From a comparative examination of the spectra of thirty-one elements the author concludes that the lines in the spectra of chemically allied elements correspond to each other individually or in groups, each chemical group having its characteristic spectra, the spectra of the various individuals differing from each other in a change of position of homologous lines, and the wave-lengths of these homologous lines corresponding to the chemical power of the element, a greater wave-length accompanying a more intense chemical power.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 18, October 29, 1877.

The Telephone of Mr. Graham Bell.—M. Breguet.—A short illustrated description of this instrument. The author remarks that of all known telegraphs it is the one which acts under the influence of the feeblest currents.

Experiments on the Disruptive Discharge made with a Chloride of Silver Battery.—MM. Warren de la Rue and H. W. Müller.—An account of results, which have been described in detail in a paper read before the Royal Society.

Rheostatic Machine.—M. G. Planté.—This paper would be unintelligible without the accompanying illustration.

Action of Anhydrous Acids upon Anhydrous Bases—M. J. Béchamp.—(See page 221.)

Determination of Reductive Sugar contained in Commercial Products.—M. Aimé Girard.—The reductiv sugar pre-existing in the sample is first determined directly. To this end, after having raised to a boil 100 c.c. of a well prepared cupro-potassic liquor, resisting this test, the author pours into it quickly a known volume of the saccharine solution, so large that a part only of the cupro-potassic liquor may be decomposed. The mixture is kept at a boil for a minute or two, and as soon as the precipitate of suboxide has taken the fine red tint characteristic of the granular state it is thrown upon a rapidly-acting filter, and washed with boiling water till the washings are no longer alkaline. The filter is then folded up, placed in a large platinum boat, dried rapidly over the gas-lamp, and burnt in the air. After cooling, the boat is reduced into a glass tube, and reduced in a current of pure hydrogen. The determination of the reductive sugar and the saccharose taken together is effected in the same manner after inversion. Another portion of the saccharine solution, mixed with hydrochloric acid, kept in the water-bath according to the indications of Clerget, then diluted with water, and boiled for a few moments after dilution, is in the same manner brought in contact with an excess of the cupro-potassic liquor, the suboxide is collected, washed, dried, burnt, and lastly reduced by hydrogen. From the weight of copper furnished by the first operation it is easy to deduce the weight of the reductive sugar. 1 grm. of reduced copper corresponds to 0·569 grm. of reductive sugar. As for the weight of copper furnished by the second operation, after having deducted the weight corresponding to the pre-existing reductive sugar, and having applied to the remainder the proportional correction required by the difference of the equivalents of reductive sugar and of saccharose, a correction represented by $\frac{1}{19}$, the weight of the saccharose contained in the sample is calculated.

Reductive Sugar of Commercial Products in its bearings upon Saccharimetry.—M. H. Morin.—Not adapted for abstraction.

Production of Racemic Acid in the Manufacture of Tartaric Acid.—M. E. Jungfleisch.—Without denying that certain vines may produce racemic acid under unknown conditions, the author holds that this substance, when met with in manufactories, takes its rise under the joint action of heat and alumina, or an analogous oxide.

Certain Physical Properties of Quercite.—M. Prunier.—An account of the crystallographic characters of quercite, its action upon polarised light, and its specific gravity.

Journal für Praktische Chemie.
Nos. 9 to 13, 1877.

On Quinons.—E. Carstanjen.—The author has rendered a valuable service to our knowledge of the structure of quinons by preparing from cymene,—

$$C_6H_4(CH_3)(C_3H_7)1.3,$$

a quinon and an oxyquinon identical with those derived from thymol, $C_6H_3(CH_3)(OH)(C_3H_7)1.3.4$. Cymophenol, the only isomeride of thymol—

$$(\text{position } (CH_3)(OH)(C_3H_7)1.2.4),$$

yields, upon being subjected to the same processes of oxidation, successively $C_{10}H_{12}O_2$ and $C_{10}H_{12}O_3$, compounds perfectly identical with thymo-quinon and oxy-thymo-quinon. The results would support the opinion that the oxygen atoms in quinons cannot occupy the meta-position, and tend to show that they do not occupy the positions of both the amido groups of the diamido compound from which oxythymo-quinon is directly formed, but that the HO group and one amido group unite to form

the quinon, the other hydroxyl group being replaced by a new hydroxyl.

Acid Periodides. By H. Jörgensen. A purpureo-cobalt-chloride ... $(NH_3)_4Pt$.

$$(NH_3)_4PtCl_2O_2(OH)_2 + 2HI = (NH_3)_4PtCl_2I_2 + 2H_2O + O_2$$

is obtained by adding a solution of I in HI to the solution of acid sulphate of purpureo-cobalt-chloride. The olive-green crystals are not very stable, decomposing in the air and in the aqueous solution. Similar compounds are formed with the radical $4NH_3Pt$. As these acid periodides show the same physical characteristics as the iodides of potassium-platinum cyanides, the author regards them as well-defined bodies, not molecular compounds, explaining their structure on the theory of the polyvalence of iodine. An appendix contains the crystallographic properties of a number of periodides.

Thermo-chemical Investigations (xxiv. Platinum and Palladium).—J. Thomsen.—The author gives a detailed account of a variety of experiments on the various salts of these metals, accompanied by tables of the results. They coincide with the chemical deportment of Pt and Pd, the former showing the greatest stability in the tetratomic compounds, the latter in the diatomic.

Signs of the Times.—H. Kolbe.—The editor of the journal attacks, in no measured language, a recent *brochure* by J. H. van't Hoff, on "The Position of Atoms in Space," as well as the recommendation of it by Prof. Wislicenus. The work is regarded as characteristic of the present time, when there is not only a poverty of criticism, but a hatred of it; and resultant from the increasing lack of general culture, as well as of thorough scientific training on the part of professors of chemistry. "It is in consequence of this, that that trivial, fatuous natural philosophy, with its profound intellectual air, which fifty years ago was thrown to one side by exact investigators, is at present rescued by pseudo-philosophers from the lumber-room harbouring the hallucinations of the human mind, and the attempt made to smuggle it—like a painted and bedizened courtezan—into society where it has no right."

Action of K_2SO_3 on Quinons.—E. Carstanjen. A reaction ensues at once when the solutions are brought together, and the potassium salt of the hydroquinon-sulphonic acid is formed. For example:—

$$C_6H_4O_2 + SO_3K_2 + H_2O = C_6H_5SO_5K + KHO.$$

Thermo-chemical Investigations (xxv. Magnesium, Calcium, Strontium, and Barium).—J. Thomsen.—The results of the experiments show that not only the physical, but the thermo-chemical properties of the compounds of these four metals alter regularly with the atomic weights. With an increase in the atomic weight, increase—(1) the stability of the oxy-hydrates, and the thermal development by union with H_2O; (2) the solubility of the hydrates in water, and the heat of solution of the same; (3) the heat of union of the chlorides, bromides, iodides, nitrates, and sulphates. With an increase in the atomic weight, decrease—(1) the affinity of the five mentioned salts to H_2O, the amount of water of crystallisation, and the amount of heat developed in uniting with it; (2) the solubility of these salts, the heat developed in solution, and their deliquescence in moist air. The atomic weight is entirely unconnected with the heat of neutralisation when the hydrates are dissolved in water, and with the total amount of heat connected with their formation. With regard to the salts of the same metal with Cl, Br, and I, it was found that with an increase of the atomic weight of the electro-negative element, the heat of formation of the haloid compounds decreased, while the affinity to water, the heat of union with water of crystallsation, the solubility, the heat of solubility, and the deliquescence increased. Of all metals Mg, Ca, Sr, and Ba developed the greatest amount of heat in the formation of the hydrate from I at metal. They show also the greatest affinity for O of all elements thus far examined, and approach the alkaline metals very nearly in affinity to Cl.

Action of Monochlor-acetic Acid on Sulpho-cyanic Acid and its Salts.—M. Nencki.—The reactions were undertaken with the view of comparing them with the results obtained from the isomeric sulpho-urea, which yields glycolyl-sulpho-urea. Aqueous solutions of CNSH are easily acted upon as follows:—

$$CNSH + ClCH_2CO_2H + H_2O = C_3H_5NSO_3 + HCl,$$

forming carbamine-sulpho-acetic acid, which is easily dissolved and crystallised. It forms no salts, decomposing in the presence of metallic oxides into cyanic acid and sulpho-glycollic acid. The reaction between $CNS.NH_4$ and $ClCH_2CO_2H$ is very violent, and gives rise to rhodanic acid, $HS.CH_2CO.S.NC$, a finely crystallising body, which yields, with solutions of metals possessing a strong affinity for S, mixtures of simple and double salts. It is easily changed by weak oxidisers into rhodanin red,—

$$C_6H_3N_3S_5O_3,$$

which imparts a brilliant intense orchil-red to fabrics, and a violet dye-stuff not yet analysed. The present expense of preparing mono-chlor-acetic acid unfortunately prevents the practical application. Blue and yellow dye-stuffs have likewise been obtained from rhodanic acid.

Action of Mono-chlor-acetic Acid on the Sulpho-cyanates of Aromatic Monamines. J. H. Jager. Aniline and toluidin give rise to analogous bodies of the general formula—

$$\begin{matrix} HN \\ C_6H_4HN \end{matrix} > CS.CH_2CO_2H,$$

which have acid characteristics, but form no salts. Their constitution is evidently quite different from that of the rhodanic acid mentioned above, the compounds decomposing in contact with acids into phenyl- or toluyl-carbamide and sulpho-glycollic acid.

Benzoyl-carbonic Acid.—H. Kolbe.—The author, after recounting the history of the priority of his discovery of the preparation of propionic acid from the action of HKO on $C_2H_5.CN$, in connection with Frankland as opposed to the claims of Dumas, criticises sharply the names used by Claisen, and Hübner and Buckler in their recent discovery of $C_6H_5COCOOH$ (Chem. News, xxxv., 142, 217). The appellations "phenoxylic," "phenyl-glyoxylic," "aromatic pyruvic acid," and a "true ketone acid" are regarded as scientifically incorrect. Benzoyl-carbonic acid and formyl-benzoic acid he considers the correct terms for the two acids $C_6H_5COCOOH$ and $C_6H_4(OCH)COOH$, both of which are regarded as possible.

Derivatives of Paroxy-benzoic Acid.—O. Hartmann.—The author prepares potassium phenylate in large quantities, by a rapid evaporation of a mixture of HKO and phenol, and interruption at the right moment. The preparation of paroxy-benzoic acid from the treatment of C_6H_5OK with CO_2 is so simplified that it is as practical as the present methods of manufacturing salicylic acid. A number of salts are carefully described. Paroxy-benzamide was prepared from the ethylic ether by means of NH_3, and found to crystallise well, uniting with both acids and bases. By distillation with P_2O_5 the amide yields paroxy-benzo-nitrile, or para-cyano-phenol,—

$$C_6H_4(OH)(CN),$$

which resembles greatly the meta-cyano-phenol of Griess, but is entirely different from the salicylimid of Limpricht.

Action of Cyanogen on Albumen.—O. Loew.—By varying the amount of C_2N_2 passed through a solution of albumen, the author obtains additive compounds of $2CN,3H_2O$, of $4CN,8H_2O$, and of $8CN,16H_2O$ with albumen ($C_{72}H_{112}N_{18}SO_{22}$), which lose in the presence of alkalies a part of their cyanogen and H_2O, and give rise to peculiar bodies rich in N. When an excess of C_2N_2 was used, a group, $C_{14}H_{23}N_{11}O_{10}$, oxamoidine, was separated from the albumen molecule.

Osmium Oxysulphides.—E. v. Meyer.—Two of these compounds, $Os_3S_7O_5.2H_2O$ and $(OsSO_3)_2.3H_2O$, were obtained by passing H_2S through a solution of osmic acid. They are extremely unstable, and form with NH_3 compounds which do not lose their N below 200°.

Mineral Analyses.—C. Winkler.—Roselith, —

$$3RO,As_2O_5+2H_2O,$$

is found not to contain $3H_2O$, as asserted by Skraup. A new member of the calcite group, cobalt spar, consisting of nearly pure $CoCO_3$ has been found at Schneeberg. The mineral termed bismutho-spärite is ascertained to be pure carbonite of bismuth, $Bi_2O_3CO_2$. The composition of the urano-circite from Falkenstein is—

$$BaO,2U_2O_3,P_2O_5,8H_2O.$$

Oxysulpho-arsenite of Barium.—L. F. Nilson. A compound of this character was found in the mother-liquor from which the salt, $2BaS.As_2S_3+5H_2O$, had separated. Its composition is $5BaS.2As_2S_2O+6H_2O$, and it is the first evidence of the existence of an oxy-sulphide of the trivalent arsenic.

Reimann's Färber Zeitung,
No. 38, 1877.

This issue contains nothing of general scientific interest.

No. 39, 1877.

The principal article in this issue is an account of the carbonisation of the vegetable impurities in wool by means of chloride of aluminium, prepared, it is said, by the double decomposition of barium chloride and aluminium sulphate. The precipitated sulphate of alumina, *blanc fixe*, is used not merely as a pigment, for finishing white cottons and linens, in the paper manufacture, &c., "but—*horribile dictu*—even for the adulteration of flour."

No. 40, 1877.

The leading article in this issue is devoted to the denunciation of a Belgian manufacturer who is charged with having forged Dr. Reimann's signature to a circular which he has issued.

A report, said to have originated in England, is being spead to the effect that arsenious acid dissolved in glycerin is now used as a mordant for a black dye upon cotton.

MISCELLANEOUS.

Society of Arts.—The programme of the arrangements for the coming session has just been issued. The opening meeting will be held on the 21st inst. At the second meeting, on the 28th, a paper will be read on "The Telephone," by Prof. Bell, the inventor, and among the other papers to be read before Christmas is one on "Freedom in the Growth and Sale of the Crops of the Farm considered in its Bearings upon the Interest of Landowners and Tenant Farmers," by J. B. Lawes, F.R.S. Three courses of "Cantor Lectures" are announced:—First course, on "The Manufacture of Paper," by William Arnot, F.C.S.; second course, on "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment," by Thomas Bolas, F.C.S.; third course, on "Some Researches on Putrefactive Changes, and their Results in Relation to the Preservation of Animal Substances," by B. W. Richardson, M.D., F.R.S. The second and third courses do not commence till after Christmas, as is also the case with the first meetings of the Chemical, African, and Indian Sections. An additional course of three lectures, on "Explosions in Coal Mines," is to be delivered by T. Wills, F.C.S., on three evenings in January and February. It is stated that the conference on "Health and Sewage of Towns" is to be repeated, and that a second "Congress on Domestic Economy" will be held this year at Manchester.

Iridescent Glass.—Those of our readers who have time for gazing into shop-windows must have noticed a recent addition to our fictile manufactures of a number of ornamental vases, cups, bowls, &c., of clear white glass, covered with beautiful iridescent films of different colours, and marked at unconscionably dear prices. At first it was thought that the process consisted in submitting the glass to the action of a deoxidating flame, and that the colours—like those tiresome black shams that would always disfigure our first attempts at test-tubes—was caused by the reduction of the lead; but the specification of the patent tells a different story. The inventor of the process is M. L. Clémandot, a French civil engineer, who has patented it in France, England, and America. The principle of the process appears to consist in submitting the glass vessels to the action of dilute hydrochloric, sulphuric, or other acid, under a pressure of from two to six atmospheres. M. Clémandot claims to be able to imitate the beautiful nacreous films on ancient glass which has been submitted to the combined action of air and water for two or three thousand years; but the ornamental vessels already exhibited, although very pretty, are a long way off the poorest specimens of Assyrian or Egyptian glass in any ordinary collection. Time is evidently an important factor in bringing about this singular change. In any case M. Clémandot's productions are very beautiful, but we do not see why they should fetch such exorbitant prices.

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THE CHEMICAL NEWS.

VOL. XXXVI. No. 940.

VOLUMETRIC ESTIMATION OF SULPHURIC ACID IN WATERS.

By P. HAUEST, Dr. Phil.

ALTHOUGH, for sanitary purposes, an opinion of the character of a natural water may be formed without the estimation of all its mineral ingredients, and especially of sulphates, it is highly desirable in many cases—for brewing, as an instance, and other manufacturing purposes—to find by an easy and ready method the exact amount of sulphuric acid bound to alkalies, as well as that present as calcic and magnesic sulphates.

In the following lines I shall give a short description of a volumetric method which enables, in a few hours, to ascertain accurately the quantity of sulphuric acid combined with fixed alkalies and with earthy metals.

As water charged with alkaline carbonates cannot have any other salts of earthy metals but carbonates, all the sulphuric acid present is consequently in combination with alkalies. The standard solutions employed are centinormal oxalic or sulphuric acid, and, if thought necessary, centimormal ammonia.

The process is divided into two operations:—Estimation of sulphuric acid in the alkaline sulphate; then estimation of the whole sulphuric acid, the difference being that in combination with earthy metals.

Take 100 c.c. of the water (if sodic and potassic carbonates be present neutralise with dilute hydrochloric acid); add a slight excess of baryta water; then pass in a current of carbonic gas, or mix with it water highly charged with this gas; let it boil for a few minutes, and filter. The precipitate is washed with boiling water till the washings are neutral to test-paper; and the filtrate, which contains now the alkalies as carbonates, is titrated with the above-mentioned centinormal oxalic or sulphuric acid.

The amount of acid consumed is exactly the same as that originally combined with potash and soda. Lime and magnesia salts having been precipitated as carbonates cannot interfere with the process.

Simultaneously with the first operation the second part may be carried on. The same number of cubic centimetres is taken, raised to boiling, carbonate of soda added till the liquid remains distinctly alkaline. It is then, after some minutes ebullition, passed through a small filter and well washed. All the sulphuric acid present is now in combination with potash and soda; lime and magnesia salts, having been converted into carbonates by the action of the sodic carbonate, are filtered out.

A sample of brewing-water, which in its natural state contained several grains per gallons of sodic carbonate, after having been charged with gypsum, showed the following results:—

Quantity Operated upon, 100 c.c.

	Centinormal Oxalic.
Used in the 1st operation	31·4 c.c.
Used in the 2nd operation	7·0 ,,
Rests	39·6

	Grains per Gall. of SO_3.
31·4 c.c. centinormal oxalic corresponds to	8·79
7·0 ,, ,, ,, ,,	19·88
39·6	11·09

The whole sulphuric acid amounted, therefore, to 19·68 grains per gallon, 8·79 grains of which were combined with potash and soda, 11·09 grains with lime and magnesia.

I may state, in addition, that the quantity of SO_3 found by the usual method was 19·67 grains.

Southampton, November 11, 1877.

DESTRUCTION OF LEATHER BY GAS.

By GEORGE E. DAVIS.

NOTICING the communication by Prof. Church on the above subject in the CHEMICAL NEWS, vol. xxxvi., p. 179, I give the following results of some experiments commenced two months ago upon the same subject.

More than two months ago one of my clients brought me some books (cash-books) which had been in daily use from 1855 to 1858 in a large office in Manchester. In the beginning of 1858 they were placed uncovered upon a shelf near the ceiling, where they remained until August, 1877. These books had been strongly bound in rough calf, and had red-basil lettering-pieces. Upon knocking the books, the leather from the backs came off as a mixture of dust and small pieces, which were very acid to test-papers.

Some of the leather carefully scraped from the back was treated with hot water, when it yielded a substance more nearly resembling india-rubber than anything else I have ever seen; this, though, only when wet, for when dry the mass was very brittle and easily powdered.

The aqueous solution contained:—

	Per cent.
Combined SO_3	2·847
Free SO_3	1·920

The red-basil lettering-piece was next examined, and found not altered much in strength, though it had suffered somewhat. The leather on digestion with water had evidently undergone but little change, as the pieces retained their shape; the aqueous solution contained:—

	Per cent.
Combined SO_3	0·99
Free SO_3..	0·87

The piece of leather underneath the letter-piece was next examined, as it was thought that the lettering-piece would have acted as a filter and kept back the SO_3 from the leather beneath it. It was very strong, though perhaps not quite as strong as new leather, and when treated with water the filtrate contained:—

	Per cent.
Combined acid	0·39
Free acid..	0·76

Now, knowing that all bookbinders use alum in the paste and that rough calf is tough to work, and therefore the paste is often put on in excess and allowed to soak in, it was thought advisable to examine another book in rather a different manner.

The back was scraped off and treated as before; part was boiled with soda, when it yielded 1·32 per cent of ammonia.

	Per cent.
Combined acid	3·46
Free acid..	2·18

The red-basil lettering-piece gave—

	Per cent.
Ammonia	1·28
Combined acid	0·87
Free acid..	1·04

Here it will be seen that the ammonia is in excess of the acid necessary to form a sulphate; but it must be remembered that *all* lettering-pieces were in those days glaired over with "glaire," or white of egg.

A large piece was cut from the side of the book, and this side was not freely exposed to the air during the twenty years it remained on the shelf; therefore it only received the products of combustion, due to the circulation of air through the pile of books. This piece from the side gave:—

	Per cent.
Ammonia	0·46
Combined SO_3	1·85
Free SO_3..	0·64

I am now repeating these experiments upon new leather, the results of which I will communicate when finished.

Barton Arcade, Manchester,
October 20, 1877.

ACTION OF SULPHURIC ACID AND OXIDISING AGENTS ON MORPHIA AND ITS SALTS.

By DAVID LINDO.

Of the various tests for morphia the colour produced by oxidising agents does not appear to have met with the attention it deserves. The well-known tint produced by adding nitric acid to the alkaloid or its salts is evidently the result of oxidation.

When the action of the acid is controlled in a manner to be presently described, a much deeper and more permanent red colour is developed than can be obtained by applying the test in the ordinary way. Fresenius quoting from Otto makes the following reference to this modification of the nitric acid test.

"If morphia, or a compound of morphia, is treated with concentrated sulphuric acid and heat applied, a colourless solution is obtained; if, after cooling, 8 to 20 drops of sulphuric acid mixed with some nitric acid are added, and 2 or 3 drops of water, the fluid acquires a violet-red colouration; gently heating promotes the reaction."

He then goes on to describe the further action produced on the addition of binoxide of manganese, or chromate of potash, either of which it is stated will develop a deep mahogany brown colour in the mixture. The reaction with nitric acid and other oxidising agents can be produced in the following simple manner:—

Place a grain of morphia or any of its salts (I used the muriate in my experiments) in a small porcelain dish, add 20 minims of pure concentrated sulphuric acid, and apply a gentle heat for a few seconds. Let the mixture cool a little, then add cautiously 60 minims of distilled water. If a drop of this mixture is placed on a white porcelain surface and touched with a slender glass rod moistened with nitric acid, a beautiful deep red colour will be developed, which remains unchanged for a considerable length of time.

The reaction is not confined to nitric acid; every oxidising agent I have tried produces the same red colour if applied to a solution of morphia in sulphuric acid prepared as above. All the following substances can be used in this way as tests for morphia. Iodic acid, ferricyanide of potassium, bichromate of potash, chlorate of potash, and most of the nitrates.

These reagents are best applied in small quantities in the solid state. Binoxide of manganese, peroxide of gold, and peroxide of lead can also be used.

It is indispensable that the concentrated sulphuric acid should be allowed to act on the morphia, or its salt (aided by a gentle heat), before water is added, for if the alkaloid or its compound is dissolved at once in dilute sulphuric acid, the reagents will produce little or no effect on the solution.

If the tests are applied to a solution of morphia (or its salt) in concentrated sulphuric acid, to which solution no water has been added, some of them will not act at all, and thers will produce reactions which are very well known already. On adding iodic acid, for instance, iodine will be set free; and a green colour will be developed with bichromate of potash from reduction of the chromic acid.

The smallest visible quantity of morphia or its salts in the dry state can be tested by the method I have proposed. It is merely necessary to heat the particle gently with a small drop of sulphuric acid, add 2 drops of water afterwards, and apply any of the oxidising agents named above to the solution.

I give the preference to iodic acid, ferricyanide of potassium, nitric acid, and the nitrates; when the latter are used it is sometimes necessary to apply a gentle heat.

Falmouth, Jamaica,
October 18, 1877.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 15, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

After the announcement of visitors and presents to the library, and confirmation of minutes, the following certificates were read for the first time:—T. C. Cloud, G. F. Dowdeswell, A. Ginders, A. Linnel, D. A. Louis, S. P. Pickering, and J. Woodland.

The PRESIDENT then announced that Professor Odling being unable to attend, his paper on Gallium would be postponed till the next meeting of the Society.

The following papers were read:—

"*First Report to the Chemical Society on some points in Chemical Dynamics*," by Dr. WRIGHT and Mr. LUFF. From certain theoretical considerations the authors thought it probable that the temperature at which a body A begins to act on a compound BC in accordance with the reaction $A+BC=AB+C$ is a function of *a*, the physical condition of the substances, *b*, the heat disturbance (evolution or absorption) taking place during the change; and *c* the chemical habitudes of the bodies, possibly expressible as numerical values constant for each substance. An elaborate series of experiments has therefore been made to find out the temperatures at which the actions of carbonic oxide, hydrogen, and free amorphous carbon on oxide of iron or oxide of copper are first perceptible. Various specimens of oxides in different states of physical aggregation were prepared, in some instances by special devices so as to obtain products free from all traces of organic matters derived from washing-water, filters, &c. The temperatures at which carbonic oxide begins to act on these bodies were determined by keeping portions of them in a tube at various temperatures, passing pure carbonic oxide (carefully freed from admixed oxygen—from air) over them, and noting the temperature at which the issuing gases first rendered baryta-water turbid. The temperature of initial action of hydrogen was obtained by dissolving the substances, after exposure to its action, in hydrochloric acid, or hydrochloric acid and ferric chloride, and testing by permanganate or ferricyanide. The temperatures at which carbon begins to act were found by observing when gas began to be evolved on heating in a Sprengel vacuum, due corrections being made for small quantities of carbonic oxide and carbonic acid occluded by the carbon, and gradually given off by it during heating. Two kinds of carbon were used—one a dense sugar-charcoal, well roasted, ignited in a current of chlorine, and again heated in a closed platinum crucible till no more hydrochloric acid came off; the other, a light pulverulent carbon obtained by acting on ferric oxide with carbonic oxide at about 400° C., and dissolving out the reduced iron by hydrochloric acid. The general results of these

experiments are as follows :—(1) The temperature at which the action of a given reducing agent on a given metallic oxide is first perceptible depends on the physical condition of the metallic oxide, and, if carbon be the reducing agent, also on the physical condition of the carbon. (2) Hydrogen uniformly begins to act on a given oxide in a given physical state at a lower temperature than carbon, and carbonic oxide begins to act at a lower temperature than hydrogen. (3) When the physical state is about the same, a given reducing agent begins to act on copper oxide at a lower temperature than on iron oxide. (4) The two last conclusions are special cases of the general rule that *the greater the algebraic value of the heat disturbance* (*i.e.*, the more heat evolution or the less heat absorption) *the lower the temperature at which the action is first noticeable.* (This rule is, however, not general for all metallic oxides, as it does not apply in the case of iron and tin oxides.) Thus in the case of the reactions—

(1) $CuO+CO_2=Cu+CO_2$. (2) $CuO+H_2=Cu+H_2O$,
(3) $2CuO+C=2Cu+CO$,

there is respectively an evolution of heat to the extent of +30·05, +19·52, and +9·48 kilogrm. heat units per 16 grms. of oxygen transferred from metallic oxide to reducing agent. In the corresponding actions of these agents on Fe_2O_3 the heat disturbances are +1·90, −8·63, and −18·67. In the reduction of cuprous oxide there is almost the same heat disturbance as in that of cupric oxide (by the same reducing agent.) Hence the temperature of initial action on Cu_2O of each agent lies very close to that found for CuO, in fact within the limits afforded by variations in physical state. The action of carbonic oxide on precipitated cupric oxide is noticeable at a temperature much lower than 100°; at 100° carbonic oxide is wholly converted into carbonic acid by heating it in sealed tubes with some oxide. By passing carbonic oxide over cupric oxide at 100° pyrophoric copper is soon obtained almost free from oxide. If the carbonic oxide contain a trace of air, the partially reduced oxide serves as a conveyer of oxygen to the carbonic oxide, thus producing much more carbonic acid than that due to the cupric oxide acted on. The actual temperature values obtained with chief specimens examined are given in the following table :—

Substance.	Initial Temp. of Action with—			
	CO.	H.	Sugar C. C	frm.CO.
Copper oxide by precipitation	60°	85°	390°	350°
Ditto by ignition of nitrate..	125	175	430	390
Ditto, prolonged heating of metal	146	172	440	430
Cuprous oxide	110	155	380	345
Ferric oxide, by calcining $FeSO_4$	202	260	450	430
Ditto, precipitated	90	195	450	—
Ditto, precipitated, and gently ignited..	220	245	450	430

Dr. Gladstone pointed out that the above paper was the first fruits of the Research Fund, and was therefore of special interest to the Society. He complimented the authors on opening out a new region of thought and experiment, and on the success with which they had overcome the great difficulties they had met with in obtaining substances sufficiently pure for their experiments.

Mr. Vernon Harcourt asked if any experiments had been made as to the effect of time on the reactions: whether, for instance, given an unlimited time, a reaction would not go on to the end at a comparatively low temperature. He would also like some further explanation of the term "algebraic value of the heat disturbance."

Mr. Wills enquired whether, after heating, cooling, and re-heating a substance several times, a rising of the initial temperature of reaction did not take place; also how it was possible to compare the action of a solid body, as carbon, with the action of gases such as hydrogen.

After some remarks by Messrs. Kingzett, Neison, and Drs. Dupré and Armstrong,

Dr. Wright briefly replied to Mr. Harcourt that experiments of the kind indicated were in progress; that the above term was used simply to express the production of heat, whether it was a positive or a minus quantity, and that "heat disturbance" was simply a translation of the German word "Wärmetönung." In reply to Mr. Wills Dr. Wright said that the temperature did rise, and so care was taken always to have fresh samples for each experiment: that as regards the relative action of a solid and a gas, the solid would no doubt act very much less rapidly, but this would not affect the temperature at which the action commenced.

The next paper was communicated by Mr. C. T. Kingzett, "*On the Chemistry of Cocoa-Butter* (*Part I. Two New Fatty Acids*)." The specimen of cocoa-butter examined was hard, imperfectly transparent, slightly yellowish, melting at about 30° C., and when once melted remaining liquid for some time at a lower temperature: it contained no volatile or soluble fatty acids. The acids were prepared by saponifying the butter, and decomposing the soaps with dilute sulphuric or hydrochloric acid. They were purified by recrystallisation from alcohol, fractionating, &c. Many analyses and melting-points of products obtained are given. The extreme acids found were represented by the formulæ $C_{12}H_{24}O_2$ and $C_{64}H_{128}O_2$. The first is the formula of lauric acid, but it melts at 57·5° (lauric acid melting at 43° C.), so it must contain some acid of a higher melting-point than lauric acid, and therefore the acid itself must be lower in the series $C_nH_{2n}O_2$ than lauric acid. The highest known acid in this series is melissic acid, $C_{30}H_{60}O_2$, the new acid has a formula not lower than $C_{64}H_{128}O_2$. Many salts of these acids were prepared, but details as to their composition are reserved for a future communication. The lower acid crystallises in pearly plates or fine long needles. The higher acid—for which the author proposes the name of "Theobromic Acid"—crystallises in microscopic needles or granules, melts at 72·2° C.: at a high temperature distils apparently unchanged, and is somewhat electric when dry, a property which is possessed in a high degree by its silver salt. The total fatty acids of cocoa-butter contain about 20 per cent oleic acid. The author, in conclusion, points out that text-books state that "cocoa-butter yields, almost exclusively, stearic acid." From the present investigations it is clear that this statement is entirely incorrect. It is based entirely on determinations of the melting-point of the fatty acids obtained.

Mr. Duffy said that from the proportion of carbon he should have expected a higher melting-point, observing that a very small quantity of a fatty acid containing a low percentage of carbon had an enormous effect on the melting-point of a high acid, perhaps from some kind of solvent action.

The next paper was read by Dr. Armstrong, "*On the Influence Exerted by Time and Mass in certain Reactions in which Insoluble Salts are Produced*," by M. M. P. Muir. In this paper the author has worked out in detail a suggestion given by Dr. Gladstone (*Chem. Soc. Journ.*, ix., 54) to the following effect:—"It is easily conceivable that where the affinity for each other of two substances that produce an insoluble compound is very weak the action may last some time, and become evident to our senses. Is not this actually the case when . . . carbonate of soda in solution is added to chloride of calcium?" The author has taken solutions containing known quantities of calcium chloride and potassium or sodium carbonate, and allowed them to stand for a certain number of minutes after mixing, collected the precipitate formed, and thus has obtained approximate results, which are, however, strictly comparable among themselves. These results the author has represented graphically in curves. The greater portion of the chemical change takes place during the first five minutes, afterwards the reaction decreases very much in rapidity. The relative masses of the salts exert an important influence. Thus if the mass of alka-

the carbonate be four times that required by the equation $CaCl_2 + MCO_3 = MCl_2 + CaCO_3$, the action is completed in five minutes, but if the salts are mixed in equivalent quantities the action is not completed in forty-six hours. For short periods of time potassium carbonate yields more calcium carbonate than sodium carbonate. An increase of the temperature produces in every case an increase in the amount of calcium carbonate formed in a given time, whilst dilution causes a marked decrease. Dilution with sodium and potassium chloride solution gives a still more marked decrease. A discontinuous addition of one of the solution to the other causes the action to reach a maximum more quickly than when the solutions are mixed at one time, but the maximum so reached is no greater than that which is finally attained under the latter conditions. In conclusion the author gives the results obtained by mixing solutions of calcium sulphate and sodium chloride, allowing them to remain for four weeks, and then estimating the calcium sulphate decomposed. When 14·2 molecules of sodium chloride were used to 1 of calcium sulphate 32·9 per cent of the latter was decomposed. Further experiments on this subject are promised. (See Graham, *Chem. Soc. Journ.*, iii., 60). Graham has shown that sulphates of potassium and sodium are decomposed by lime-water, yielding diffusates containing caustic potash and soda respectively. The above experiments show how the chlorides of the alkalies may yield sulphates, and these in turn may furnish the alkaline carbonates required by plants.

The Society then adjourned to December 6, when the following papers will be read:—(1) "On Gallium," by Prof. Odling; (2) "On the Constitution of the Terpenes, and of Camphor," by Dr. Armstrong; (3) "On Potable Waters," by Dr. Mills.

ERRATUM.—Throughout the abstract of Mr. Perkin's paper (read Nov. 1), p. 211, for "cinnenyl" read "cumenyl."

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

October 13, 1877.

Professor C. LIEBERMANN, Vice-President, in the Chair.

BRIEF mention of the loss to the Society through the death of its Secretary was made by the presiding officer.

The following papers were presented:—

C. LIEBERMANN and H. PLATH confirm Rosenstiehl's "*Formula of Pseudo-purpurin*," $C_{14}H_4(OH)_3.O_2.CO_2H$, *i.e.*, purpurin-carbonic acid. When heated for a short time with HKO it is changed completely into purpurin.

J. H. VAN'T HOFF establishes the following law on the "*Connection between Optical Activity and Constitution*:" The optical activity disappears in those derivatives of active bodies, by the formation of which the so-called asymonetry of the carbon atoms ceases. For example, the inactive succinic acid prepared from dextro-tartaric acid, and the inactive amylen and methyl-amyl derived from active amylic alcohol.

O. FISCHER, "*Condensation Products of Tertiary Aromatic Bases.*" Treatment of meta-bromo-dimethyl-aniline with phthalic chloride gives the phthalein of the former, $C_{24}H_{22}Br_2N_2O_2$, a bluish compound, forming with acids reddish yellow solutions. Dimethyl-aniline forms with benzaldehyd a base from oxygen as follows:—

$$C_7H_6O + 2C_6H_5N(CH_3)_2 - H_2O + C_{23}H_{26}N_2.$$

With furfurol it forms a similar base.

A. HORSTMANN, "*Relative Affinity of Oxygen to Hydrogen and Carbonic Oxide.*" The author gives the results of his experiments on the truth of Bunsen's law, that when an insufficient amount of O is used the ratios between the volumes of the products of combustion, H_2O and CO_2, always can be expressed by *small whole* numbers. The law which he establishes in its place is that "The ratio between the volumes of the two gases [illegible] to that between the amounts of H and CO, under [illegible] coefficient of affinity which is independent of the ratio between the original combustible gases, but dependent on the relative amount of O present." Among the facts noticed are—(1) With increasing amounts of oxyhydrogen gas, and the same amount of CO, the ratio of H_2 to CO_2 increases gradually and not by sudden alterations. (2) The presence of H_2O vapour diminishes the amount of H burned, and CO is affected in the same way by the presence of CO_2 in the mixture of gases. (3) There is always more H relatively than CO burned, so that the affinity of O for H is greater than for CO.

L. [illegible], "*The [illegible] corresponding to the Fourth Nitro-[illegible]*." By heating a mixture of benzaldehyd and ethyl-nitrate into H_2SO_4 the author obtained, besides the ordinary nitro-benzaldehyd, an isomeride, a yellowish oil boiling at 196°; which, when oxidised with chromic acid, yields the fourth isomeric nitro-benzoic acid lately discovered by him.

J. THOMSEN finds the "*Water of Crystallisation in Auric Chloride-hydrochlorate*" to be as follows:—

$$AuCl_4H + 4H_2O.$$

A. LADENBURG maintains his position with regard to the "*Valence of Nitrogen*," by giving a detailed account of his experiments, showing the distinct individualities of the two bodies,—

$$N(C_2H_5)_3.C_2H_5I \text{ and } N(C_2H_5)_2.C_2H_5.C_2H_5I,$$

in answer to Meyer's criticisms.

H. W. VOGEL criticises "*Chastaing's New Theory of the Chemical Action of Light*," recently published in the *Ann. de Chem. et Phys.*, which claims that the action of the various coloured rays of the spectrum on inorganic bodies is dependent on their refrangibility, the red and yellow acting as oxidisers; the green, blue, and violet as reducing agents; while all rays induce oxidation in organic bodies. A number of experiments from Hunt, Herschel, Wollaston, and others are adduced to show the incorrectness of the theory, and to establish the law that "rays of all varieties can induce an oxidising or reducing action, according to the nature of the body by which they are absorbed."

A. MICHAEL has succeeded by the "*Action of Br on Ethyl-phthalionide*," in introducing for the first time halogens into the alcoholic radicals of amines. After introducing an acid radical into ethyl-amine it is easily brominated, yielding dibrom- and tribrom-ethyl-phthalionide.

A. CHRISTOMANOS describes "*Lecture Experiments*" for exhibiting the development of heat by the union of water and HCl or NH_3, which consist essentially in inserting into cylinders containing these gases thermometers, the bulbs of which are enclosed by moistened paper or cotton. In HCl gas the temperature mounts rapidly to 70°.

E. J. DRAGOUMIS renders the "*Determination of Temperatures*" more certain and simple by using two thermometers, one of which is below the temperature to be measured, and the other heated above it. If these are dipped into a liquid, for example, the exact temperature is ascertained when they both stand at the same height.

E. HEPP describes some "*Aldehyd Derivatives*," in which the O of the aldehyd group is occupied by two amido groups. Methylal and benzyl-cyanide in the presence of $C_2H_4O_2$ and H_2SO_4 form methylen-diphenyl-acetamide, $CH_2(NH.CO.CH_2.C_6H_5)_2$. In the same way benzyl-cyanide and chloral form trichlor-ethyliden-diphenyl-acet-amide, $CCl_3.CH(NH.CO.CH_2C_6H_5)_2$, and aceto-nitrile and chloral, trichlor-ethyliden-diacetamide, $CCl_3.CH.(NH.CO.CH_3)_2$. They all crystallise in small white needles, and are very insoluble.

The same prepares "*Azophenetol*" by the action of HKO and zinc-dust on nitrophenetol in alcoholic solution, obtaining quantitative results; and describes a "*New Formation of Hydroquinon*," which consists in the action of hydroxylamin on a solution of nitroso-phenol in HNaO.

C. COUNCLER, "*Boric Ethers.*" Allyl-borate unites

with Br to form a hexabromide ($C_{10}H_{14}Br_6O_3$). It is a brown viscous liquid. An isobutyl borate, $(C_4H_9O)_3B$, was obtained from boric anhydride and isobutylic alcohol. Boric chloride and benzyl-alcohol yield dibenzyl, $(C_7H_7)_2$.

P. P. Bedson has obtained "*Para-Isomeric Form-amido-phenyl-acetic Acid*," $C_6H_4(NH_2).CH_2.CO_2H$, by reducing the three nitro-derivatives of para-bromo-phenyl-acetic acid.

O. Kraft finds that the "*Salts of Terocrylic Acid*" are changed into those of an isomeric acid by fusion with HKO. Several salts and ethers of diaterpenylic acid are described.

F. R. Japp and G. Schultz obtain a "*Phenanthren-carbonic Acid*," $C_{14}H_9COOH$, by saponification of the nitrile resulting from the distillation of ferrocyanide of potassium and potassium-phenanthren-sulphonate. It forms easily soluble salts, and is changed by oxidation into phenanthren-quinon-carbonic acid, $C_{14}H_7O_2COOH$.

L. Claisen, "*Organic Acid Cyanides.*" The author obtains by the action of HCl on benzoyl-cyanide the amide of the newly-discovered benzoyl-carbonic acid,—

$$C_6H_5.CO.CO.NH_2,$$

by interrupting the reaction at the instant when the cyanide is completely dissolved. It is soluble in alkalies, and is precipitated out on the addition of acids, but with its physical properties entirely changed, two different isomerides being produced, according to the acid used.

F. Kessel, "*Brominated Ethylic Ethers.*" By the action of Br on ethyliden-oxychloride, $(CH_3.CHCl)_2O$, the author obtains an acto-bromo-ether, $C_4H_2Br_8O$, as tetra-bromo-ethoor, $C_2H_2Br_4$, tribromo-acetic acid, and tetra-bromo-ether, $(C_2H_3Br_2)_2O$. With iodine no results were obtained.

"*Double Salts of Hyposulphite of Copper.*" The yellow salt, $Cu_2S_2O_3,Na_2S_2O_3.CuS$, is decomposed by the action of H_2O, yielding CuS chiefly. The white salt, obtained from the former by the action of HCl is decomposed in a similar manner.

H. Kammerer exhibits as a "*Lecture Experiment of the Direct Combustion of Nitrogen*" a flask in which a magnesium ribbon is burned in air, causing the formation of NO_2, which is shown with starch.

F. Gramp recommends for "*Lecture Experiments*" the combustion of zinc-turnings in a gas-flame, giving rise to an enormous dark green flame and a thick column of white ZnO; and the boiling of cadmium in a porcelain crucible, accompanied by combustion of the vapours, which colours the flame dark red, and forms a brown cloud of CdO.

A. Kastroph prepares "*Phenetol*" direct from phenol and alcohol by heating the mixture with $ZnCl_2$ or P_2O_5.

C. Willgerodt, "*Action of α-Dinitro-chloro-benzene on Sulpho-carbamide.*" The reaction, carried on in a closed tube at 150°, yields α-dinitro-phenol-mercaptan,—

$$HS.C_6H_3(NO_2)_2,$$

crystallising in yellow needles. The author finds that the reactions of α-dinitro-chloro-benzene with acid amides are only possible under pressure, and are furthered by the presence of H_2O, alcohol, and magnesia. The chief product is always an amine.

"*Action of α-Dinitro-chloro-benzene on Carbanilide.*" The reaction is as follows:—

$$CO(HNC_6H_5)_2 + C_6H_3(NO_2)_2Cl + H_2O = HN(C_6H_5)[C_6H_3(NO_2)_2] + H_2NC_6H_5.HCl + CO_2.$$

H. Salkowski, "*Anhydro Bases Derived from Triamido-Benzene.*" By treatment with acetic anhydride an acetyl-ethenyl-triamido-benzene,—

$$C_6H_3(NH.C_2H_3O)(N_2H.C_2H_3) + 2H_2O,$$

is obtained, which by the action of HCl is changed into ethenyl-triamido-benzene-hydrochlorate,—

$$C_6H_3(NH_2)(N_2H.C_2H_3),2HCl.$$

The acetyl derivative of chrysanisic acid,—

$$C_6H_2(CO_2H)(NO_2)_2NH.COCH_3,$$

s formed by heating it with acetic anhydride.

H. Hübner communicates the following researches which have been carried out in connection with students in the Göttingen laboratory:—

"*Salicylic Acid and* HNO_3." The two isomeric acids, $C_6H_3.NO_2.OH.COOH$, resulting from the nitrification of salicylic acid, have been changed into the corresponding amido-nitro-benzoic acids and nitro-benzoic acids, from which it appears that in one the position is—

$$NO_2.OH.COOH, 1.2.3,$$

and in the other $OH.COOH.NO_2$, 1.2.4 They both yield the same dinitro-salicylic acid—

$$C_6H_2.NO_2.OH.COOH.NO_2, 1.2.3.5.$$

Sulphonic acids have been obtained from some of the nitro and amido derivatives.

Dinitro-benzoic Acid and Nitramido-benzoic Acid." The acid, $C_6H_3.COOH(NO_2)_2$, obtained in large quantities from the action of HNO_3 on benzoic acid, was reduced to nitro-amido-benzoic acid, and in this, on the one hand, H substituted for NH_2 (forming meta-nitro-benzoic acid), and, on the other hand, Cl substituted for NH_2 and NO_2 eliminated, yielding meta-chloro-benzoic acid; thus showing that both NO_2 groups in the dinitro acid occupy the meta position, and that negative groups on entering benzoic acid usually take the meta position to the COOH group. A number of salts and ethers of the two acids are described.

"*Brominated Benzoic Acids.*" These include two di-bromo-benzoic acids obtained from the isomeric meta-bromo-ortho-nitro-benzoic acids, three tribromo-benzoic acids, three dibromo-salicylic acids, para-meta-bromo-nitro-benzoic acid, $C_6H_2.Br_2.NO_2.COOH$, and the corresponding amido-acid, para-bromo-metamido-benzoic acid, brom-nitro-salicylic acid, and a number of derivatives.

"*Nitro-benzanilides and* HNO_3." The ortho- and para-compounds yield the same trinitro-benzanilide, $C_6H_3.NO_2.NO_2.NH(CO.C_6H_4.NO_2)$, while the meta forms three other isomeric compounds. Mono- and dibromo-derivatives of these nitranilides are also described.

"*Anhydro Bases.*" The nitro derivatives of the α- and β-benzoyl-xylidins yield on reduction anhydro-diamido-benzoyl-xylens, $C_6H_2.(CH_3)_2..N_2H...C.C_6H_5$. Meta-nitro-benzmesidin, $C_6(CH_3)_3H_2.(NH.COC_6H_4.NO_2)$, yields with HNO_3 a mono and dinitro compound. Other bases described are nitro-meta-nitro-benz-para-toluide,—

$$C_6(CH_3)H_3.NO_2.(NH.COC_6H_4NO_2);$$

anhydro-toluyl-diamido-benzene,—

$$C_6H_4..NH_2...C.C_6H_4.CH_3;$$

the corresponding diamido-toluen, and diamido-xylen. Nitro derivatives of succin-naphthyl, $C_{10}H_7N(COC_2H_4CO)$, have also been obtained.

"*Ortho-nitro-benzo-nitril*" has been formed from the nitro-benzamide, and reduced to the corresponding amido-benzo-nitrile, $C_6H_4.NH_2.CN$.

"*Acetophenon*" forms on nitrification—

$$(C_6H_4.NO_2)CO.CH_3,$$

which gives rise to an amido compound, and forms meta-nitro[a]benzoic acid by reduction.

"*Replacement of Diazo Groups by the Group* SO_3H." This is accomplished by submitting the compounds to the action of sulphurous acid in alcoholic solutions. Meta- and para-diazo-imido-benzoic acids are thus changed into the corresponding meta- and para-sulphi-benzoic acids, $C_6H_3(COOH)(SO_3H)$.

"*Iodine Cyanide and Amides.*" The best method of preparing and separating the three isomeric nitranilins from each other is detailed. By treatment with CNI they give rise to carbo-nitro-tetra-imido-benzenes,—

$$(C_6H_4.NO_2.NH)_4C,$$

in which the NO_2 can be reduced to an amido-compound, and this in turn with HNO_2 changed into a nitroso-azo-oxy-hydroxyl derivative,—

$$\left.\begin{matrix}(C_6H_4.OH.N)_2O\\(C_6H_4.OH.N_2O)_2\end{matrix}\right\}C.$$

"*Action of Amylic Iodide and Iodine on Anhydro-Benzoyl-diamido-benzene.*" $C_5H_{11}I$ alone causes the formation of a dark red insoluble compound,—

$$C_6H_4..\begin{cases}NI_2\\N(C_5H_{11})_2\end{cases}...C.C_6H_5.$$

Accompanied by iodine, it yields a black crystalline body,

$$C_6H_4..\begin{cases}N\\(N.C_5H_{11})\end{cases}...C.C_6H_5+4I.$$

An ethylic derivative corresponding to the first-mentioned has been obtained.

P. T. Cleve, "*Sulpho Derivatives of Naphthalen.*" α-nitro-naphthalen-sulphonic acid is obtained by the action of H_2SO_4 on nitro naphthalen, and by treating the α-sulphonic acid with HNO_3, and changed by reduction into an amido-acid, which yields with HNO_2 the α-diazo-naphthalen-sulphonic acid, $C_{10}H_6(N_2)(SO_3)$, and with H_2O, α-dioxyl-naphthalen, $C_{10}H_6(OH)_2$. The β-nitro-sulphonic acid is derived directly from the β-sulphonic acid. The sulpho-naphthalide $(C_{10}H_7)_2SO_2$, formed as a by-product by the action of H_2SO_4 on $C_{10}H_8$, has been examined, and changed with PCl_5 into the β-sulphon-chloride and β-chlor-naphthalen. The naphthionic acid, prepared from naphthylin with H_2SO_4, gave with HNO_2 the diazo-acid, $C_{10}H_6(N_2)(SO_3)$, and with PCl_5 a dichloro-naphthalen. Two other dichloro-naphthalens were formed by distillation of the two sulphonic acids with PCl_5.

O. Wichman describes all of the "*Chloro-derivatives of Naphthalen*" now known, to the number of which he has added some new bodies. The list includes, among the substituted derivatives, $C_{10}H_7Cl$ (2 isomerides); $C_{10}H_6Cl_2$ (7 isomerides); $C_{10}H_5Cl_3$ (4); $C_{10}H_4Cl_4$ (4); $C_{10}H_3Cl_5$ (1); and $C_{10}Cl_8$ (1). Among the additive products are $C_{10}H_8.Cl_2$ (1); $C_{10}H_8.Cl_4$ (1); $C_{10}H_7Cl.Cl_4$ (2); $C_{10}H_6Cl_2.Cl_4$ (3); and $C_{10}H_5Cl_3.Cl_2$ (2).

J. A. Carleson has prepared several "*Amido-derivatives of Naphthalen-sulphonic Acid*," such as—
$C_{10}H_7.SO_2.NHC_6H_5$, by the action of aniline, ethylamine, and naphthylamine, on the sulphon chloride.

A. G. Ekstrand, "*Sulphonic Acids of Retene.*" By the action of H_2SO_4 at ordinary temperatures the disulphonic acid, $C_{18}H_{16}(SO_3H)_2$, results, while the trisulphonic acid is produced at 100°.

C. G. Lindbom, "*Cyanides of Gold.*" A large number of various salts with the metals are described, such as KCy.CyAu, KCy.CyAuCy$_2$, KCy.CyAuI$_2$, NaCy.CyAuBr, &c.

N. Engstrom gives the "*Analyses of Several Rare Minerals*," such as orthite, vasite, endmannite, tritonite, and orchenite.

NOTICES OF BOOKS.

Shorthand for General Use. By J. D. Everett, M.A., D.C.L., Professor of Natural History in the Queen's College, Belfast. London: Marcus Ward and Co. 1877.

Such an immense quantity of work has to be gone through now-a-days in so short a time that any effort to reduce labour must be looked upon as a boon. Possibly the readers of the Chemical News for 1977 will have learned shorthand at school, where it ought to be taught, and will be able to write the word "though" with two movements of the pen instead of with about twenty, as is the case in the present year of grace. Prof. Everett's little manual, although somewhat beyond our ken, seems to be an excellent one. His method is partially phonetic, like Pitman's: he also uses thick and thin strokes for the hard and soft consonants. The great difference, however, between this system and all others is the substitution of characters for the vowels instead of diacritical marks; in fact, to speak philologically, Prof. Everett's is an Aryan system, where each letter has its distinct character, whereas all others are Semitic systems, in which the vowels are either left out or indicated by diacritical points. To an outsider this appears a manifest improvement, although practised shorthand writers decry it as a heresy, possibly for the same reason that they condemn every other system but their own—because it is not their own. The proof of the pudding, however, is in the eating, and the Professor tells us at the annual examination of the Belfast Phonetic Shorthand Writers' Society he was awarded a certificate for a hundred and sixty words a minute—a speed exceeding by ten words a minute that of the fastest of his competitors.

Judging from an outsider's point of view, we should be inclined to recommend this little work to all would-be phonographers.

Harvard University: Bulletin of the Bussey Institution. Vol. ii., Part 2, 1877.

This issue is chiefly devoted to inquiries into the dietetic value of certain vegetables, such as pumpkins, vegetable marrows, blue-joint grass, Canary reed-grass, the dandelion, and the nettle. Neither the writers nor the European authorities quoted seem at all aware to what an extent the last-named plant is eaten as a spring-vegetable in some parts of the north of England.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 19, November 5, 1877.

Hydrogenation of Benzine and of Aromatic Compounds.—M. Berthelot.—The author has pointed out ten years ago a general method for saturating organic compounds with hydrogen, consisting in the use of an aqueous solution of hydriodic acid saturated in the cold, and employed in large excess and for a considerable time at a temperature of from 275° to 280°. This method applied to the compounds of the aromatic series as well as to those of the fatty series furnishes the successive terms of hydrogenisation up to the extreme limit of the formenic or saturated carbides, more difficult to attain with the compounds of the aromatic series. Thus benzol, the fundamental pivot of the aromatic series, has been transformed into a saturated carbide, volatile at 69°, the composition and properties of which are the same as those of the hexylen hydride obtained by MM. Pelouze and Cahours from American petroleum.

Liquefaction of Acetylen.—M. Cailletet.—When acetylen is compressed, its initial temperature being +18° at the pressure of 83 atmospheres, numerous drops are formed and flow along the inner sides of the tube. If the pressure is reduced some atmospheres the liquid is suddenly resolved into gas, and the tube is for a moment filled with a dense mist. Liquid acetylen is colourless and very mobile; it seems to refract light strongly; it is much lighter than water, in which it dissolves to a large extent. It dissolves paraffin and fatty matters. If liquid acetylen is cooled to zero in presence of water and linseed oil, there is formed a white, snow-like solid, which is again destroyed if gently heated, or if the pressure is reduced, with the evolution of numerous bubbles of gas. Acetylen is liquefied at the following pressures:—

At + 1°	48 atmospheres.
2·5°	50 ,,
10°	63 ,,
18°	83 ,,
25°	94 ,,
31°	103 ,,

Hydride of ethylen at +4° is liquefied at 46 atmospheres.

Action of Hydrochloric Acid upon Two Isomeric Butylenes and upon the Olefines in General.—J. A. Le Bel.—The ethylenic carbides, whose structure may be represented by the formulæ—

$$CH_2=CRR' \text{ and } CHR=CR'R'',$$

combine with cold hydrochloric acid. On the other hand, the hydrocarbides $CH_2=CHR$, and probably those represented by the formula $CHR=CHR'$ are not attacked.

Alteration of Eggs Induced by Mould Derived from without.—A. Béchamp and G. Eustache.—Hen's eggs may be preserved for a long time in a medium abounding in infusoria without these being able to traverse the shell and penetrate into the interior. But microscopic moulds can penetrate both the shell and its lining, and develop themselves in abundance on its internal surface.

Biedermann's Central-Blatt für Agrikultur Chemie, Heft 6, June, 1877.

The Summer Rain-Periods of Germany.—G. Helt. mann.—There occurs in Germany a double maximum, both in the quantity and the frequency of rain for the summer months. The first maximum, as regards quantity, falls in the beginning of the second half of June; as regards quantity, in the beginning of July. The second maximum for both is in the middle of August.

Researches on the Action of Water containing Carbonic Acid upon certain Minerals and Rocks.—Dr. J. Müller.—The minerals and rocks examined were adular from St. Gothard, oligoklas from Ytterby, hornblende rock from Altenburg, magnetic iron ores from the Zitterthal and from the Kaschberg in Bohemia, meroxite from Hammond, in St. Lawrence County; apatite from Katharinenburg; asparagite from Chili; olivesic rock from the Ultenthal, in Tyrol; noble serpentine from Snarum. All these rocks and minerals were decomposed by water containing carbonic acid. Lime, potassa, soda, and the protoxides of iron, manganese, nickel, and cobalt were converted into carbonates. When alkaliferous silicates, such as adular and oligoklas, were acted on, small quantities of silicic acid were dissolved, probably as hydrate. Even alumina was dissolved in a minute quantity. The reddening of felspar is the first stage of decomposition, and the formation of kaolin the second. Augmented pressure promotes the action of carbonic acid water more than increased time. The behaviour of magnetic iron ore with hydrochloric acid throws no light on its decomposibility by carbonic acid water. Apatite dissolves much more readily in such water than might be expected from its appearance under the microscope.

Researches on the Capillary Conduction of Water in the Soil, and on its Capillary Saturability with Water.—Dr. von Klenze.—An important treatise, to which it would be impossible to do justice in the space at our disposal.

Nature of the Peruvian Guano now imported into Belgium.—Prof. A. Petermann.—The percentage of nitrogen in guano is found to be continually sinking, and ranges at present from 2 to 9.

Contamination of the Air by Cesspools, and on the Efficacy of the Ordinary Disinfectants.—Dr. F. Erismann.—Eighteen cubic metres of excrement as found in cesspools gives off in twenty-four hours 11·144 kilos. of carbonic acid, 2·040 of ammonia, 0·033 sulphuretted hydrogen, and 7·464 carburetted hydrogen, forming a total of 20·681 kilos., or, in round numbers, 18·79 cubic metres of irrespirable gases! The author considers copperas, and especially sulphuric acid, as the best disinfectants.

Means for Preventing Putrefaction and Destroying Stenches.—A. Eckstein.—The author considers chloride of lime the most powerful agent for deodorising privies. He proposes to use it wrapped up in parchment-paper to prolong its action. He found that the aqueous solution of 1 kilo. of copperas destroyed the odour of H_2S in a privy used daily by at least 100 persons. After twelve hours the action was at end. The action of sulphate of copper was similar. 1 kilo. of solid copperas acted for two days. 1 kilo. of a mixture of copperas and sulphate of copper with carbonate of lime acted for two days. Liquid sulphurous acid acted very rapidly: for one hour it was oppressive to breathe, and its action had disappeared after twenty-three hours. Crude carbolic acid added to the extent of 30 grms. diffused so unpleasant a smell for two days that its local action could not be observed. 1 kilo. of copperas in a bag of parchment-paper only began to act in two hours, and kept the place inodorous for three days. 1 kilo. of good chloride of lime in a similar bag acted perfectly for nine days. 60 grms. permanganate of soda acted immediately, but its effect ceased in twenty-four hours. If enclosed in parchment-paper it was efficacious for two days. Chloride of lime along with sulphuric acid is pronounced the most powerful disinfectant (deodoriser?) known.

Moniteur Scientifique Quesneville. November, 1877.

Report on the Exhibition of Dyed and Printed Goods, and of Chemical Products held on Occasion of the Fiftieth Anniversary of the Industrial Society of Mulhouse.—M. Theodore Schneider.—MM. Kopp and Goppelsrœder, professors at the Chemical School, exhibited the results of the spectrum-analysis of a great number of colours and of dyed and printed tissues. The results are given in a series of 200 drawings. Among the dyes examined are murexide, magenta, azalein (?), eosin, yellow and red corallin, picric acid, dinitro-naphthalin, Lyon blue, cyanin, diphenylamin blue, green, blue, and violet ultramarines, aniline-blacks, aldehyd and methyl greens, Hofmann's, Poirier's, and Perkin's violets, &c. For plastic, opaque, or insoluble colours like ultramarines, aniline-blacks, &c., the analysis has been limited to the examination of the projection-spectrum obtained by placing a very fine glazed paper, previously covered with a uniform layer of colouring matter, in the many-coloured bundle of rays emerging from a flint glass prism. As for the colours soluble in water, alcohol, or any other medium, they have been examined directly with the spectroscope. Beginning with solutions containing 1 part in 1000 the authors carried on the dilution in geometrical progression until the normal spectrum was reached, *i.e.*, until the influence of the dye upon the spectrum became imperceptible. 1 grm. of colouring matter was thus successively dissolved in 1, 2, 4, 8, . . . 64 litres of solvent. The authors purpose to continue the researches on this subject, and to examine in succession if one and the same colouring matter prepared by different methods, or produced directly upon the tissue, presents the same spectrum; what may be the influence of the homologue, and the isomerism of the organic radicals introduced into dyes as regards shade and tinctorial power; what is the influence of the basicity of the acids combined with coloured bases and that of the acidity and the nature of the bases combined with coloured acids. They will compare colours applied in the dry state, and without any mixture upon glazed paper with the same colours fixed by dyeing or printing according to different methods in use. Lastly, they will determine the influence of the different thickeners, as well as that of steaming and brightening. It is hoped that these researches will not only lead to a method for the rapid detection of different colouring-matters similar in shade, but that they will furnish easy and expeditious processes for determining the commercial value of certain colouring-matters, such as indigo.

Analysis of Indigo.—V. Tantin.—The author points out the inaccuracy of all the volumetric processes depending upon the action of an oxidising agent upon

indigotin, inasmuch as gluten, indigo-brown, and indigo-red enter also into the reaction. The method of Houton Labillardière he considers in itself exact, but the colorimeter of this chemist is not trustworthy within 10 per cent. In its place he recommends an improved colorimeter by J. Salleron, which he figures and describes, and which enables very slight differences in the intensity of two shades of colour to be distinctly recognised. His method of operation is as follows:—

1. *Taking the Specimen.* About 5 grms. are scraped with a knife from the merchants' sample. If the latter is composed of several pieces, a quantity is scraped off each, proportionate to its weight.

2. *Pulverisation and Sifting.*—The 5 grms. of indigo taken for analysis are ground in an iron mortar and passed through a sieve of silk having 100 meshes to the square centimetre. The pulverisation and sifting should be continued till nothing remains, for if the harder fragments less easily ground are rejected, the process cannot show the real value of the indigo.

3. *Weighing.*—0·30 grm. of each indigo under examination is then weighed out in a balance sensitive to ½ milligrm.

4. *Selection of a Standard.*—We take *pure indigotin*, which may be obtained by collecting the scum which forms constantly upon the surface of the indigo vats, and treating it with hydrochloric acid diluted with water in order to remove all foreign matter. The residue from this operation, very carefully washed upon a filter and dried, is preserved in bottles with ground-glass stoppers. The comparison of the samples with this standard demands much attention. It should be used merely to determine the value of some indigo which may in turn serve as a standard for other samples.

5. *Solution of the Indigos in Sulphuric Acid.*—The 0·30 grm. of each sample and of the standard is introduced into flasks of a peculiar form, known as assay-flasks. To each must be added 10 grms. of pounded glass previously washed and perfectly dried, and into each flask is poured by means of a pipette 5 c.c. of sulphuric acid chemically pure. The author attaches great importance to the use of this acid in preference to that of Nordhausen, which gives purple solutions in which the eye with difficulty recognises slight variations of intensity. The flasks are heated in a water-bath to a temperature of 60° to 70°, taking care to agitate every half-hour. After the lapse of four hours, the solution of the indigotin being complete, the product in each case is diluted with water and made up to 3 litres. For the sake of exactness this dilution is carried on in a narrow-necked flask which holds 3 litres up to a mark on the neck. The liquid is then allowed to settle for half an hour before transferring it into the colorimeter.

6. *Comparison of the Intensity of the Solutions in the Colorimeter.*—10 c.c. of the solution under examination are poured into the right-hand tube of the colorimeter, and the same measure of the standard solution into the left-hand tube. The latter will ordinarily be the deeper (invariably if pure indigotin is taken for a standard). By means of the burette attached to the instrument a few drops of water are poured into the left-hand tube, and by means of the caoutchouc tube air is gently blown in, so as to mix thoroughly the coloured solution and the water added. If the two liquids have not yet exactly the same shade more water is added by small portions, blowing in air each time till perfect equality is reached. The number of c.c. of water used is then read off, and the value of the indigo under examination will be inversely as the figures obtained. To have results absolutely exact we ought to compare only indigos from the same locality, for it is very evident that for equal percentages of indigotin a Bengal indigo should have a superior value to one from Java or Guatemala.

The Latest Researches on Aniline-Black.—A summary of recent improvements in the production of aniline-blacks, which have been already laid before our readers.

Determination of Phosphorus in Iron Ores.—Carl Holtoff.—The author's object is to ascertain the causes to which are due the differences in the proportion of phosphorus contained in iron ores, and he reviews the methods in use for its determination. One of them consists in disaggregating the ore with carbonate of soda and a little silica. This method he puts aside as inconvenient. He examines that which depends on the precipitation of the phosphoric acid as basic ferric phosphate in a feebly acetic and boiling solution, dissolving then in hydrochloric acid the precipitated phosphate and the basic ferric acetate, adding citric acid to the solution, saturating with ammonia, and precipitating the phosphoric acid with magnesia mixture. The result is always too small. It is necessary to re-dissolve in hydrochloric acid the last precipitate, which always retains some iron, and to recommence the rest of the operations, renewing the cause of loss, which depends on the solubility of the ammonio-phosphate of magnesia in citrate of ammonia. Do we sometimes omit to keep the solution of ferrous acetate at a proper temperature? Does the ferric acetate formed under these circumstances dissolve the precipitate of ferric phosphate? Or is this last precipitate itself soluble in ferrous acetate? Without attempting to solve these questions the author examines the method, which consists in precipitating the phosphorus by the molybdic solution, dissolving the precipitate of ammoniaco-molybdic phosphate in ammonia, partially neutralising the ammonia with hydrochloric acid, and precipitating the phosphoric acid by the magnesian mixture. The results, according to the author, have always been very satisfactory. They agree equally when the solvent has been hydrochloric acid, provided that the molybdic solution is in large excess, *i.e.*, at least 60 c.c. of solution for each centigrm. of phosphoric acid in solution, provided that the free hydrochloric acid does not exceed 2 per cent, that the whole is allowed to stand a sufficient time for the precipitate to settle, and that the whole is not raised above blood-heat. Comparative experiments made with the same quantities of liquid have not given notable differences when the hydrochloric acid had been eliminated and replaced by nitric acid by means of evaporation in the water-bath, and the addition of strong nitric acid. In this case, however, the separation of the precipitate is much more rapid, and is further accelerated by heating. The determination may, then, be effected even in hydrochloric solutions, but it is an important condition of success not to heat the liquid strongly. If the hydrochloric solution of iron, mixed with nitric acid and molybdate of ammonia, is heated, the nitric and hydrochloric acids decompose each other respectively, the solvent of the molybdic acid disappears, and this acid is separated. The phospho-molybdate of ammonia at first precipitated becomes soluble again in the supernatant liquid, and which is almost free from molybdic acid. Apparently the chlorated compounds set free decompose the ammonia in the double salt; this is destroyed and the phosphoric acid becomes soluble again. This is the cause that in liquids filtered from the above solutions after being strongly heated, and which have always a distinct odour of chlorine, we may always detect and determine very considerable quantities of phosphoric acid by further additions of molybdic acid. In many laboratories it is customary when using this method to heat to 60° and upwards the hydrochloric solution of the substance under analysis, after the addition of the molybdic mixture. Here, without doubt, lies the cause of the discrepancies complained of. There is a further cause of error in the execution of this method. The precipitate formed by magnesia mixture in the solution of the phospho-molybdate of ammonium in dilute ammonia, after being almost neutralised with hydrochloric acid, has been to this day regarded as pure ammonio-magnesian phosphate. The author has been in the habit of re-dissolving this precipitate in hydrochloric acid and re-precipitating with ammonia, and on examining the filtrates has always been able to obtain from them considerable precipitates by

treatment with phosphoric acid or hydrogen phosphide. He has certainly prepared the magnesian mixture with magnesium sulphate. But he has found by repeated trials that even the reagent prepared with magnesium chloride gave precipitates which, if weighed, dissolved in hydrochloric acid, and re-precipitated by ammonia in large excess, so that the liquid may contain at least 3 per cent of free ammoniacal gas, showed losses of weight inexplicable by facts hitherto known. The filtrates contained magnesia as well as molybdic acid, and so much the more as the original precipitate was more flocculent. He has often found that the precipitates thus obtained after two precipitations contained molybdenum, although he has not been able to find the cause of this fact. To be certain that we have nothing but pure ammonio-phosphate of magnesia and to be able without doubt to assume 27·93 per cent of phosphorus in the calcined precipitate, he prefers to dissolve in as little hydrochloric acid as possible the first precipitates obtained; to evaporate the solution to dryness, in order to separate the small quantities of silicic acid present; to re-dissolve in a few drops of silicic acid and hot water; to treat with sulphuretted hydrogen so as to throw down all the molybdenum; then after filtration and concentration to precipitate with ammonia and after standing for twelve hours in a cool place in a well-covered beaker, to filter, and thus to conclude the process.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 8, October 25th, 1877.

This issue contains no original chemical matter.

No. 9, November 1, 1877.

This issue contains no chemical matter.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
No. 47, November, 1877.

Report Presented by M. Salvetat on Behalf of the Committee of the Chemical Arts on the Coloured Muslin Glass of M. Aubriot.—After having enumerated the methods now in use for rendering glass less transparent, the author describes M. Aubriot's process, which consists substantially in applying to the surface of the glass a vitrifiable colour mixed with gum-water, drying, steaming, and heating in the muffle. Patterns of any kind can be easily produced.

Report Presented by M. Salvetat on Behalf of the Committee of the Chemical Arts on the Works of Appert Brothers, Manufacturers of Enamels, Glasses, Crystals, and Vitrifiable Colours.—The nature of this paper appears sufficiently from the title.

Report Presented by M. Schützenberger on Behalf of the Committee of the Chemical Arts on the Mechanical Manufacture of Paper Filters Invented by MM. Laurent.—The inventors have constructed a machine for folding sheets of paper automatically, and converting them into filters ready for use.

Reimann's Färber Zeitung,
No. 41, 1877.

In an article on the valuation of dye-wares the editor objects to colorimetric methods that they are untrustworthy when the samples to be compared have not exactly the same tone, *e.g.*, when a greenish indigo is compared with pure indigotin which has a reddish cast. Further impure dyes, such as a tarry magenta, appear relatively darker than pure samples containing the same proportion of colour. Spectroscopic methods are objected to as too complex, requiring costly apparatus and as being applicable to substantive colours only. The portion of colour which adheres to the sides of the tube impoverishes the solution to an extent very serious where such small quantities also are employed.

MISCELLANEOUS.

University of London.—The following is a list of the candidates who have passed the recent Second B.Sc. Examination:—(Old regulations) *First Division.*—A. Cutfield, Epsom College, and Christ's College, Cambridge; B. A. De Watteville, M.A., University College; J. V. Elsden, private study; W. Hudson, private study; H. F. Morley, M.A., University College; J. M. Raby, B.A., private study; W. J. Spratling, University College and private study. *Second Division.*—D. E. Anderson, B.A., University College; J. K. Bond, B.A., private study; W. Brown, private study; R. H. Cotton, B.A., Owens College; A. C. Dixon, private study; W. Fream, Royal College of Science, Dublin; G. A. Freeman, St. John's, Batersea, and private study; T. S. Humpidge, University of Heidelberg; D. Ross, B.A., private study; A. Simpson, B.A., F. C. Divinity Hall, Aberdeen; L. C. Wooldridge, First M.B., Guy's Hospital. (New regulations) *First Division.*—A. Black, private study; G. C. Frames, Christ's College, Cambridge; W. H. Higgin, Owens College; R. H. Jude, Christ's College, Cambridge; T. Lattimer, St. John's College, Cambridge; D. McAlister, St. John's College, Cambridge; R. C. Rowe, M.A., Trinity College, Cambridge; W. L. Wills, Owens College. *Second Division.*—A. Atmaram, University College; E. H. Cook, Royal College of Science, Dublin; J. W. Evans, University College; J. L. McKenzie, private study; J. H. Paul, private study; H. Robson, private study; J. Shirley, private study; R. H. S. Spicer, St. Mary's Hospital.

The American Association for the Advancement of Science.—The meeting of this Association for 1878 will be held in August at St. Louis, Missouri. The following is a list of the general officers elected for that meeting:—President, O. C. Marsh, of New Haven; Vice-President, Section A., R. H. Thurston, of Hoboken; Vice-President, Section B., A. R. Grote of Buffalo; Chairman of Permanent Subsection of Chemistry, F. W. Clark, of Cincinnati; Chairman of Permanent Subsection of Microscopy, G. S. Blackie, of Nashville; Permanent Secretary, F. W. Putnam, of Cambridge; General Secretary, H. Carrington Bolton, of Hartford; Secretary of Section A., F. E. Nipher, of St. Louis; Secretary of Section B., George Little, of Atlanta; Treasurer, W. S. Vaux, of Philadelphia.

Russian Scientific News.—In this correspondence I will give some news regarding the recent progress of mining explorations in Russia. In the Society of Naturalists M. Pechatkin made a report on the occurrence of very rich iron ores in the Berdiansky district of the Tavris Government. Beds of magnetic iron ore, situated in the vicinity of the mountain Corsak, have the following dimensions:—700 feet long and 210 feet in breadth; the thickness of this layer is 70 feet. Near this place several other beds of magnetic iron ore of different size were examined. This ore contains 70 per cent of iron, and no sulphur or phosphorus. Near these rich iron mines brown hematite was also found in notable quantities, containing about 65 per cent of iron. The railway which is to be constructed in this district will pass near the mountain Corsak. I mentioned in my last communication about some so-called anthracite found in the Olonetz Government. It must be remarked that this mineral is not anthracite, but is a carbonaceous claystone, which gives on being ignited 32 to 40 per cent of ash containing many impurities mechanically mixed with the mineral and a sufficient quantity of sulphur to make it useless. The explorers propose to use this strange coal for boilers and metallurgical operations, and they go even so far as to maintain that this coal may be an important adjunct for foreign coals now in use in St. Petersburg. Of course

that is nothing more than words, because a fuel containing more ash than carbon, and which does not coke, has no future in metallurgy. The trial on board of a steamer showed also the total unfitness of this coal. A steamer going from St. Petersburg on fair coal reaches Cronstadt in one hour and a half: the same steamer using Olonetz anthracite reached Cronstadt in three hours' time. This fact wants no illustrations. If the Olonetz carbonaceous claystone is of no use whatever the same cannot be said about the beautiful beds of red hematite, mixed with a considerable quantity of magnetic iron ore. They are situated in the Olonetz district in the Vedlozersky parish, between the rivers Collaga, Sona, and Narvaju, about 35 miles from the Ladoga Lake. The veins of the iron ore pass through layers of reddish dolomite. The thickness of these veins is from 3½ to 18 feet. These rich iron ores astonish the explorers, as remarked M. Zemlinitzin, the Government engineer to this district. The calculations of this engineer show that the total quantity of iron ore only on the surface is not less than one million tons. The ore contains 59 to 75 per cent of metallic iron, and no sulphur. In St. Petersburg the pig-iron from these ores may be sold at 125 shillings the ton. In the vicinity there is a good quantity of cheap wood; labour is also cheap. Future iron works may compete very easily with the pig-iron brought from the Oural Mountains, which now may be had not cheaper than 185 shillings per ton in St. Petersburg. In the Eastern Siberia, from July 1, 1876, up to July 1, 1877, 15·26 tons of gold and 1·58 tons of silver were mined. The quantity of silver extracted is annually decreasing as the old mines are at present nearly exhausted. A careful exploration of Siberia is very desirable, because silver ores are very abundant in this country, as shown by several preliminary explorations.

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NOTES AND QUERIES.

Lubricating Oils, &c.—Can any of your readers tell me where I can get the best information relative to rosin greases and the proper mixing of oils for lubricating purposes? I would also like to ask at what temperature and in what proportions will tallow, palm oil, and rosin amalgamate with a soda-lye, and what strength and at what temperature should be the lye (according to Twaddle)?—INQUIRER.

Arsenic in Sulphur, &c.—Will anyone inform me of a method of estimating the small percentage of arsenic in sulphur recovered by Mond's process, or in sulphuric acid made from pyrites? Mr. H. A. Smith, in his work on sulphuric acid manufacture, gives the quantities of arsenic found in pyrites acid and the secondary products, HCl, SO_4Na_2, &c., but omits the process which he used.—T. W.

TO CORRESPONDENTS.

J. Cope.—Faraday's or Williams's "Chemical Manipulation."

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GEOLOGY.—In the Preface to the Student's ELEMENTS of GEOLOGY, by Sir Charles Lyall, price 9s., he says:—"As it is impossible to enable the reader to recognise rocks and minerals at sight by aid of verbal descriptions or figures, he will do well to obtain a well-arranged collection of specimens, such as may be procured from Mr. TENNANT (149, Strand), Teacher of Mineralogy at King's College, London." These Collections are supplied on the following terms, in plain Mahogany Cabinets:—

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THE CHEMICAL NEWS.

Vol. XXXVI. No. 940.

VARIEGATED LEAVES.

By A. H. CHURCH, M.A.,
Royal Agricultural College, Cirencester.

The question of "albication," "albinism," or the white variegation of leaves, does not appear to have been yet approached from the chemical side. In studying the composition, modes of occurrence, and physiological position of the common colouring-matters of plants, I have been working at albication, in the hope of acquiring information concerning chlorophyll. My results so far seem to open up a new path of inquiry. The experiments were begun too late in the year, and under the serious disadvantage, from which much of my phyto-chemical work here suffers, of the absence of a greenhouse. Still, I have obtained some striking results, which if confirmed by further analyses, and supported by the very obvious synthetical experiments which they suggest, may throw much light, and must throw some, upon the nature and production of chlorophyll.

The experiments, of which I now propose to give an abstract, were performed with three plants having their green leaves variegated with white patches, or else bearing both white and green leaves. The plants were—1, *Acer Negundo*; 2, *Hedera helix*; 3, *Ilex aquifolium*. The microscopic appearances were not neglected, but are purposely not alluded to here. I shall designate the plants simply as maple, ivy, and holly, respectively, in this communication.

The maple leaves were from trees in the Agricultural College Botanic Garden, and were gathered on Sept. 17. The holly was obtained from Messrs. Jefferies's nurseries on Sept. 24. For the ivy I am indebted to Mr. Taylor, of Cirencester, a number of plants being laid under contribution, the date of collection being October 4. In every case I gathered the leaves myself, and without the intervention of knife or scissors. Weighed bottles received the specimens, so that no moisture could be lost during transit to the laboratory. It is scarcely necessary to say that every precaution was taken to gather only such leaves as could fitly be compared in age and condition of growth. The water, the combustible or volatile matter, and the ash were first of all determined. The results, translated into percentages, are here arranged in a tabular form :—

	Maple.		Holly.		Ivy.	
	White.	Green.	White.	Green.	White.	Green.
Water	82·83	72·70	74·14	62·83	78·88	66·13
Organic matter	15·15	24·22	23·66	35·41	18·74	31·63
Ash..	2·02	3·08	2·20	2·47	2·38	2·24

The watery character of the white leaves, and their comparative poverty in combustible, or so-called "organic," constituents, is very marked. It may be said, speaking broadly, that the fresh green leaves of all three plants contained one-third more solid matter than the white leaves. The mineral matter or ash, when not absolutely more abundant in the white leaves, forms a larger part of their dry matter.

The nitrogen in both ivy and holly was found more abundant in the dry matter of the white leaves than in that of the green; but the percentages of nitrogen found in the fresh leaves of the two plants were such as to render further analyses necessary.

The matters soluble in ether were estimated in the dried leaves of holly and ivy. Of these matters, including wax or fat, resin, chlorophyll, and several other organic compounds, fresh white ivy leaves contained 1·29 per cent, the green giving 3·27 per cent. Similarly, white holly leaves contained 1·75 per cent, and green holly 2·54 per cent.

But the most remarkable differences in composition between white and green leaves were noticed on submitting the ashes of the several plants to quantitative analysis. The nature of the results may best be seen by the following table :—

Percentage Composition of Ash.

	Maple.		Holly.		Ivy.	
	White.	Green.	White.	Green.	White.	Green.
Potash	45·05	12·61	35·30	16·22	47·20	17·91
Lime	10·89	39·93	21·50	34·43	12·92	48·55
Magnesia ..	3·95	4·75	3·23	2·43	1·11	1·04
Ferric oxide ..	(?)	(?)	3·11	3·11	2·62	2·31
Phosphorus pentoxide ..	14·57	8·80	9·51	7·29	10·68	3·87

Although the above figures will require some correction (owing to the carbon dioxide of the various ashes not having been deducted); and although several important ash constituents, such as chlorine and sulphur trioxide, have yet to be taken into account before a final judgment can be formed, yet these percentages already teach us a good deal. In the ash of all three plants there is the same kind of difference between the white and green parts. In the ash of the white parts potash abounds, and in the ash of the green parts lime; while in the ash of the white parts there is invariably a higher proportion of phosphates than in that of the green. There is, however, no indication that the presence of chlorophyll in the green parts involves a higher proportion of iron. On the whole, the composition of the ash, as of the organic part of these plants, suggests a comparison of the white parts with the younger and more active parts of ordinary plants, while the green parts resemble the more mature organs. At present, further deductions would be hazardous, but a series of synthetical experiments on variegated plants is at once suggested by the foregoing analyses, and by the observation that, in some calcareous soils, many variegated plants quickly revert to their normal green condition. I hope before long to report the results of growing variegated plants in soils nearly destitute of lime, but abundantly supplied with potash salts and phosphates.—*Gardener's Chronicle*, p. 580, 1877.

WHY MILK SOURS DURING THUNDER-STORMS.

By MALVERN W. ILES, Ph.D.

There have been various surmises with regard to this subject; none, so far as we have been able to learn, have been substantiated by experiments.

In order to see if milk really did sour during heavy rain and thunderstorms I made several observations which proved to me that the opinion so commonly held by dairymen was not erroneous.

My experiments to arrive at the cause of the phenomena thus observed may be stated as follows :—I filled an eudiometer tube (300 c.c.) with skimmed morning's milk, then introduced 100 c.c. pure oxygen gas; then, by the use of an ordinary battery and a small Ruhmkorff coil, sparks of electricity were made to pass through the oxygen for five minutes. The current was then broken, the tube shaken up, and allowed to stand for five minutes. The milk did not appear quite so opaque, and showed a noticeable acid reaction. On continuing the current for five minutes longer, making in all ten minutes, the milk curdled very perceptibly, and showed a decided acid reaction. The contents of the tube, on standing for

twenty minutes, had reached the consistency of ordinary sour milk, or "bonny-clabber."

From the above experiments it will be seen that the oxygen was converted into ozone, which we think may be stated as the cause of the rapid souring of milk during thunderstorms.

The increased acidity is due to the formation of lactic acid, and most probably some acetic acid, by means of the ozone, one or both of these acids thus causing the casein to be precipitated.

Baltimore, November 5, 1877.

THE ANALYSIS OF TIN ORES.

By A. E. ARNOLD.

As tin generally occurs in the form of cassiterite, it is to the analysis of this mineral, in its impure state, to which I refer.

Tin is frequently estimated in the dry way by fusion of the ore with potassium cyanide, but to ensure accuracy it is always advisable to make a second assay. The results thus obtained are not so correct as when the tin is precipitated from its solution as sulphide or hydrate.

The difficulty of obtaining dioxide of tin in solution is well known. Carbonate of soda, hydrate of soda, carbonate of potash and borax, sulphur, and carbonate of soda are each used as fluxes to render the cassiterite soluble; but this is not always effected in one fusion. When fluorhydrate of potassium or borax is used as a fondent the silica cannot be estimated, and wherever the above fluxes are employed a large quantity of fixed salts is introduced into the analysis.

By treating cassiterite, in a state of fine division, with a rather brisk current of hydrogen, at a moderate red-heat, it is completely reduced to metallic tin. If a gramme of substance is taken, about two hours' exposure will suffice. This is demonstrated by the following figures: the numbers under "Found" represent the loss of oxygen estimated by re-weighing the boats after ignition in hydrogen; under "Calculated" is the theoretical amount of oxygen present in the tin dioxide found in the sample:—

SnO_2 present.	Oxygen Loss.	
	Calculated.	Found.
I. 88·39 per cent.	18·66	18·30
II. 64·48 ,,	13·76	13·69

The tin present may be deduced with tolerable accuracy from the loss of oxygen incurred in the reduction. The above figures were not determined with this object, and are only cited in want of more exact determinations.

The reduced tin may be caused to act upon perchloride of iron in a flask fitted with a small valve, and the resulting protochloride of iron can be titrated with permanganate or with bichromate. It is preferable, if a complete analysis of the mineral is required, to treat the substance beforehand with hydrochloric acid or aqua regia, to remove the soluble gangue. This may consist of volatile sulphides, oxides of iron and bismuth, arsenic acid, and sulphides of copper and iron, which interfere with the volumetric estimation. The insoluble matter, consisting principally of silica and dioxide of tin, is filtered and weighed. It is easily transferred from the platinum crucible to a small porcelain boat, in which it is reduced. Six or eight boats at a time are conveniently ignited in a long glass tube bound with copper-foil.

The hydrogen is freed from all traces of sulphur and arsenic by nitrate of silver and soda-lime, and well dried. If arsenic acid is present arsenious acid sublimes in the tube, and reveals itself by its crystallisation; but some arsenic remains with the tin.

The contents of the boats, after cooling in hydrogen, are dissolved either in perchloride of iron, for titration, or by hydrochloric acid and potassium chlorate, for the subsequent precipitation of the tin as sulphide or hydrate.

Ten or twelve volumetric estimations of tin may thus be made in the course of twelve hours. The following analyses were made in the manner described:—

Dioxide of tin	0·64	10·04	13·85	6·93	62·73
Copper oxide	None	None	0·28*	0·99	0·47
Bismuth oxide	None	—			
Lead oxide..	None	None			
Arsenic acid	Trace	None	20·10	8·58	3·47
Silica	0·85	2·12	6·86	7·09	4·14
Manganese protoxide	0 22	None	—	0·97	0·22
Lime	48·20	42·72	10·65	25·58	10·77
Magnesia	0·66	0·52	—	1·22	0·53
Iron peroxide	12·16	7·91	43·61	25·31	9·58
Alumina				0·98	None
Combined water ..	1·47	2·27	5·68	3·97	1·19
Moisture			—	—	—
Carbonic Acid	35·80	34·42	—	18·20	7·59
Undetermined				—	—
	100·00	100·00	101·03	99·82	100·69
Metallic tin	0·50	7·90	10·89	5·45	49·34

As the foregoing process is not generally known, I consider the facility with which assays of tin ores may be conducted as described is sufficient to warrant its communication.

* As metals.

THE ACTION OF FIXED OILS UPON COPPER.

By Dr. EDMUNDS.

In connection with the research of Mr. W. H. Watson on this subject it will be of interest to readers of the CHEMICAL NEWS to know that a most perfect lubricating oil has long been manufactured by a special process from paraffin oil, and that this may still be obtained by writing to Charles Humphrey, the Dee Oil Company, Saltney, near Chester. This oil has no oxidising action upon brass-work, and it does not resinify. For lubricating the bearings of microscopes and other instruments I have long used this with great satisfaction, and know of nothing equal to it. Some time since I gave a specimen of it to Messrs. Powell and Lealand, the well-known makers of microscopes, and Mr. Powell has since told me that he never before met with any oil like it.

5, Savile Row, London, November, 1877.

A STUDY OF CYANOGEN COMPOUNDS.

By SAMUEL E. PHILLIPS.

That a brighter future awaits the evolution of a true chemical philosophy is an article of common faith, and many will feel much indebted to Mr. Sidney Lupton for his painstaking endeavour to simplify the cyanogen series (CHEMICAL NEWS, vol. xxxiii., p. 223). Some thirty years ago it was the ruling fashion to interpret these from the point of view of either Graham or Liebig. The former held that they were salts of a peculiar acid, the equivalent of which was triple that of HCy, and containing 3Cy in the radical prussine (Pr), the 3H of the acid being replaced by metals forming the prussides, &c. The hypothesis of Liebig entertained another radical constituted of Fe_1 and Cy_3, which combined with 2H, K, or other metals, the radical being called ferro-cyanogen (Cfy).

How partial and gratuitous these hypotheses were, and ill-fitted to cover all the ground, struck me very forcibly

at the time, and I then wrote a long paper on the series; but without my puny efforts, and the laboured refutation attempted, time rolls on, and these fashions are utterly extinct. Apart from foolish conceit, which time has corrected, my pride was then as now, that the views taken really covered the widest ground, and that no special hypothesis was at all requisite. Since then the fashion has been for "atomicities" *per se* with the attendant hooks or points of attachment, and other omniscient peculiarities of type and disposition. Yet still no radical iconoclast is needed, for such worthy men as Roscoe, Friedel, and others, have rebuked the folly, and its speedy diminution will be the happy consequence.

Sidney Lupton is a Goliath in the retreating confusion, and hence the endowment of cyanogen with a startling atomicity, more than rivalling the short-lived notoriety of Hofmann's elongated types of 14 atom water.

That a special hypothesis of manifold atomicity for Cy should now be set forth is exceedingly incongruous, because it is the most purely monatomic of all its negative or acidifying congeners, and such a Quixotic endeavour might be far more easily entertained for O, Cl, or S. We might thus initiate "a new study of the chlorine compounds," "and in a general review the first thing which strikes us is the large number of compounds in which Cl plays the part of a monatomic element; the second is the numerous complicated compounds containing the atom Cl more than once. Considering, then, Cl compounds as a group to themselves, it is evidently of advantage to use as our means of classification the atoms of Cl, and not, as is usually the case, the various bodies with which it may be combined, just as the paraffins, for example, are classified by the number of atoms of carbon they contain. Our next step is therefore to enquire into the combining powers of Cl as the basis of our classification," &c.

With the above unpublished manuscript before me, I would briefly indicate some of its leading features.

Cy as the + element.

IDES— CyO – CyCl – CyBr – CyI
CyF – CyS – CyS_2, &c.

SALTS— Oxy-cyanates .. .. .. KO.CyO
Chloro-cyanates .. .. KCl.CyCl
Sulpho-cyanates .. .. .. KS.CyS
Per-sulpho-cyanates .. KS.CyS_2
With corresponding bromo-, iodo-, and other salts.

Cy as the – element.

Cyan-IDES—

		Analogues.		
KCy	–	KO	KCl	KS
NaCy	–	NaO	NaCl	NaS
BaCy	–	BaO	BaCl	BaS
ZnCy	–	ZnO	ZnCl	ZnS
FeCy	–	FeO	FeCl	FeS
Fe_2Cy_3	–	Fe_2O_3	Fe_2Cl_3	Fe_2S_3
PtCy	–	PtO	PtCl	PtS
$PtCy_4$	–	PtO_2	$PtCl_2$	PtS_2
$AuCy_3$	–	AuO_3	$AuCl_3$	AuS_3
		&c.	&c.	

Cyano-SALTS—

			Oxy-, chloro- and sulpho-analogues.
Cyan-aurates ..	..	$KCy.AuCy_3$	$KO.AuO_3$
Cyan-platinates	..	KCy.PtCy	KCl.PtCl
,, ,,	..	$KCy.PtCy_2$	$KS.PtS_2$
Cyano-ferrates	..	$2KCy.FeCy$	2KCl.CuCl
Cyani-ferrates	..	$3KCy.Fe_2Cy_3$	$3KS.Fe_2S_3$
Cyano-cobaltates ..		$3KCy.Co_2Cy_3$	$3KO.Co_2O_3$
Cyano-iridiates ..		$3KCy.Ir_2Cy_3$	$3KCl.Ir_2Cl_3$
Cyano-chromates ..		$3KCy.Cr_2Cy_3$	$3KF.Si_2F_3$
		&c.	&c.

In the copy we have three columns of analogues, but they are here abbreviated to economise space.

These are only a few typical selections from the fuller outline, and the principle admits of being carried to the fullest extent, whether in mineral or organic chemistry The paper has a separate section on the indefinite character of oxy- and sulpho-cyanates, as due to their tendency to pass into isomeric ammonia forms, and thence specially exhibiting the di- and tri-condensations characteristic of that type.

We now pass in review the manifold atomicities of this quixotic endeavour.

Mono-cyanides, $(Cy_I)^I$.—These call for little remark, but we may note that if CyK be a "potassium cyanide" then CyI is also an iodine cyanide! It is so notated and so classified, but is correctly called "cyanogen iodide."

Di-cyanides, $(Cy_2)^{II}$.—It may be worth while to enquire what are the essential ideas involved in this diatomic Cy? Is it regarded as a condensation analogous with the di- and tri-ammonias? and if the molecule of the monatomic group be CyCy would that of the diatomic group be $Cy_2^{II}Cy_2^{II}$?

In the first or simplest group we have sulpho-cyanic acid, CySH or HS.CyS; and in the second or more complex series we have the simple sulphide, of which the former is a compound. This group includes some of the simplest double cyanides, and by comparing them with their analogues, the prefix di will be seen to be unsuitable.

Cy_2KAg is undoubtedly KCy.AgCy.
Cy_2KAu ,, ,, KCy.AuCy, &c.

And the corresponding double sulphides or chlorides are in nowise considered disulphides or dichlorides!

Of the sulpho-cyanogens we have—

In the mono-cyanides "sulpho-cyanic acid," HS.CyS.

In the di-cyanides "per-sulpho-cyanic acid," $HS.CyS_2$.

But why double this latter to make it $Cy_2SH.S.SH$? Or if there be merit in elongated symmetry why not make it Cy.SH.S.HS.Cy?

Tri-cyanides, $(Cy_3)^{III}$.—Of double and triple chlorides, *as chlorides*, I know nothing; while this peculiarity as affecting ammonias is indeed a familiar feature. Give them an ammoniacal interpretation and we have nothing left, for by the terms of the context (as I understand them) all such are excluded. I now propose to consider them all together.

			Variations. Amine Forms	
A.	Cyanamide	CyH_2N	$CyCu_2N$	CyH_3N,Cl
	Di-cyanamide ..	$Cy_2H_2N_2$	$Cy_2H_2Cu_2N_2$	
	Tri-cyanamide ..	$Cy_3H_6N_3$	$Cy_3H_3Ag_3N_3$	
B.	Cyanic acid.. ..	$(CO_2)HN$		
	Di-cyanic acid ..	$(CO_4)H_2N_2$		
	Tri-cyanic acid ..	$(CO_6)H_3N_3$		
C.	Cyanhydric acid..	C_2HN		
	Di-cyanhydric acid	$C_4H_2N_2$		
	Tri-cyanhydric acid	$C_6H_3N_3$		
D.	Chloride of Cy ..	C_2ClN		
	Di-chloride of Cy	$C_4Cl_2N_2$		
	Tri-chloride of Cy	$C_6Cl_3N_3$		

Of these triplets A is probably the most definite and least open to controversy, as being well known in its ammonia or indifferent hydride forms, as also in its ammonium or saltic mono-combinations; and it is well that the student should have a clear distinction throughout these series between the metal substitution in the amide and that of the true metal base in the ammonium or true salt. This is the more incumbent, because Hofmann has regarded and notated many of these di- and tri-amides as di- and tri-basic salts!

As in natural history, a profounder knowledge leads to a grander unity, by which empirical high-sounding names become obliterated in the conception of one variable species, so I have traced the insensible transitions by which the extremes, ammonium and nitric acid, become one chemical unity; and so, with a master-hand, deserving imperishable renown, Hofmann has traced the essential unity of relation between A and B series, not only in their simplest forms, but in their substituted varieties. The A. tri-cyanamide (melamine) by three stages of re-

action involving + 2HO − H_3N becomes B tri-cyanic acid (cyanuric acid)

Melamine becomes ammeline	$(CO)_2(Cy_2H_3N_3$
Ammeline become ammelinic acid..	$(CO)_2(Cy_2H_4N_3$
Melanuric acid becomes cyanuric acid	$(CO)_3H_3N_3$.

As we may invert the order of these transitions by inverse reaction inducing + 2HO, or vary them by substituting HS for HO, it is important to have a clear grasp of the meaning and the mechanism of these reactions.

Sulph-melanuric acid	$(CS_2)Cy_3H_3N_3$
$+H_3N-2HS$=sulph-ammeline	$(CS_2)Cy_2H_3N_3$, &c.

The strength of our position as against the cyanide views of Mr. S. Lupton is seen not only in the triple ammonia tendency, but more emphatically in their true saltic mono-bases, of which no account whatever is taken.

A chief characteristic of these amides is to evince an indifferent or non-combining chemical character, yet it so happens that the evidence already obtained is very much more ample and decisive than might have been expected.

We have melamine nitrate $Cy_3H_7N_3O.NO_5$; the chloro-platinate, $Cy_3H_7N_3Cl.PtCl_2$; the acetate, sulphate, and others.

We have ammeline nitrate, $CO_2Cy_2H_6N_3ONO_5$; the chloro-platinate, $(CO_2)Cy_2H_6NCl,PtCl_2$; the acetate, oxalate, sulphate, and others.

Hofmann gives a nitrate of a base of the melanuric acid type, with 3H replaced by E_2Ag, and it is strangely called "nitrate of diethyl-ether of amido-cyanuric acid"! It has the elements of $(CO_4)CyAgE_2H_2N_3O.NO_5$, and he gives a nitrate of a di-condensation—

$$(CO_3)Cy_2Ag_2E_4H_3N_6O.NO_5.$$

As C and D involve the idea of C = 6 replacing one H of ammonia, there are two manifest reasons why the evidence as yet should be tolerably slender—first, because of its heterodox and unwelcome character; and, secondly, because of its probable rarity in the play of combinations.

The extreme nitrile radicals are unwelcome (without their corresponding high atomicities) and the facts themselves are evidently not of the common sort, considerations probably more applicable to the carbon by itself; but when this feeling of prejudice and timidity has abated the following derivatives of guanadin may be better appreciated.

Formic, acetic, butyric, amylic, and caproic acids have been digested with guanidin to the following results.—

2 Guanadin—

$CyH_5N_2+(C_2H_1O_2)O.HO-4HO$ = Formo-guanadin, $C_4Cy_2H_5N_3$, and H_3N.

$(C_3H_3O_2)O.HO$ = Guanamine, $(C_4H_1)Cy_2H_6N_3$,,

$(C_5H_7O_2)O.HO$ = Butyro G $(C_5H_5)Cy_2H_6N_3$,,

$(C_{10}H_9O_2)O.HO$ = Amylo G, $(C_{10}H_7)Cy_2H_9N_3$,,

$(C_{12}H_{11}O_2)O.HO$ = Caprylo G, $(C_{12}H_9)Cy_2H_6N_3$,,

Of course our present interest centres in the formo-body (so-called), and many will be the efforts, and great the ingenuity displayed, to view this body in some other light.

M. Wichelhaus has discovered a base isomeric with "cyanide of ammonium." Its genesis is thus—"Ortho-formic acid, ether, and acetamide heated together in sealed tube at 180° C," gives a white substance, which is "Methenyl-diacetyl-diamine."

$CH(OC_2H_5)_3+2(C_2H_3ONH_2)$ =

$3(C_2H_6O)$ and $CH\begin{cases}NH(C_2H_3O)\\N(C_2H_3O)\end{cases}$

In other notation we might say—

$C_2(C_4H_5O_2)_3H_1+2(C_2H_3O_2.H_2N)$ =

3 alcohol and $C_2H_2Ac_2N_2$

Another product of the reaction is a base $C_2H_2H_2N_2$, of which the platinum salt is $C_2H_2H_3.N_2Cl_4.PtCl_2$, or $C_2H_5N_2Cl.PtCl_2$. M. Wichelhaus considers this an "amido-methenyl-imide."

I cannot take these liberties with the ammonia type, and of imides I know nothing!

$H_2NaN+2(CO)=C_2NaN$ and 2HO

Also C_2H_2NCl

Also $C_2H_5N_2Cl$.

A platinate of this latter would apparently be identical with the platinate of M. Wichelhaus.

As this reaction has two features of special interest it may be worth while to study it from different points of view. I therefore repeat the above equation in a different form and with other comparisons, notating acetyl Ac = $(C_4H_3O_2)$, and phenyl Ph = $(C_{12}H_5)$—

(1.) $C_4H_1O_2.O.3HO+2(AcH_2N)-3EO.HO=$
$=C_2Ac_2H_2N_2$

(2.) $C_2H_1O_2.O.HO+2(CyH_3N_2)-4HO=$
$=C_2Cy_2H_2N_3$ and H_3N

(3.) $C_4H_3O_2.O.HO+2(CyH_3N_2)-4HO=$
$=(C_4H_1)Cy_2H_6N_3$,,

(4.) $C_{18}H_5O_6.O.HO+2(PhH_2N)-4HO=$
$=(C_{18}H_3O_4)Ph_2H_3N_2$

Esculetine + 3 aniline − 6HO =
$=(C_{18}H_1O_2)Ph_3H_5N_3$

If the cyanogen or acetyl of (1.), (2.), (3.), are unaffected by the reaction, I do not see what other interpretation can be given to the corresponding results. Whether the "ortho-formic acid ether" of (1.) be such, or, as might appear from the character of its genesis, a substitutional methane, $C_2(C_4H_5O_2)_3H$, like $C_2E_3.H$ or $C_2H_3.H$ is not at all clearly established; and it is rather odd that the prefix "*ortho*" should really mean *exceptionally* tribasic, which the ordinary formates certainly are not! Of course many will think the hypothesis of a triatomic methenyl $(C_2H)^{III}$ is valid, but it will not bear investigation.

The radicals C_2H_1, C_4H_1, C_6H_1, C_6N_3, &c., are in some sense triatomic, just as gold is; but in every case they all replace one H of ammonia, and as we can now obtain $(C_4H_3)_3N$, so this principle in di and tri forms only awaits further extension to prove the same for all. The formo-guanamine might be $(C_2H_1)^{III}Cy_2H_4N_3$; but then how is the corresponding aceto $(C_4H_1)Cy_2H_6N_3$? With any collateral evidence we might accept the former as containing the 9 equivalents of a triamine, but in the second case it would necessitate 11 equivalents, which is inadmissible.

(To be continued.)

A DELICATE TEST FOR COPPER.

By R. C. WOODCOCK.

In the *Deuts. Chem. Ges. Ber.*, (x., 1099), a very sensitive test for copper is given, which is quite worthy of record. A zinc-platinum element is formed of two thin wires, which is then placed in the solution to be tested. Should there be much copper present, almost immediately the platinum becomes covered with a blackish deposit; but if the solution is very dilute it is necessary to leave the wires in for some hours, when of course the platinum will be only slightly, if at all, coloured. The platinum wire is now removed, washed with water, and exposed—without previous drying—for a few moments to the action of hydrobromic acid and bromine vapour, obtained by heating a small quantity of potassium bromine with strong sulphuric acid. The deposit becomes deep violet: the colour may be more easily recognised by rubbing the platinum wire upon a piece of porcelain. The author (L. Cresti) believes the colour to be due to bromide of copper dis-

solved in hydrobromic acid, and states that 0·00001 grm. Cu can be readily detected by its means.

I have repeated the experiment by dissolving metallic copper in nitric acid, and then diluting the solution until 8 c.c. contained 0·0000808 grm. Cu: 8 c.c. were then taken, and a drop of dilute hydrochloric acid added, the zinc-platinum element placed in the solution, and left for nineteen hours, after which time the Cu could just be detected by applying the above test.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

November 17, 1877.

Dr. STONE, Vice-President, in the Chair.

THE President, Prof. G. C. FOSTER, described and exhibited a very simple form of absolute electrometer, which acts on the same principle as Sir W. Thomson's trap-door form of apparatus, but can be constructed at a very moderate cost. To one arm of a balance is suspended, by silk fibres, a zinc disk, which hangs horizontally in the plane of a sheet of the same metal, forming a guard-plate; and at a distance of about 1 inch below is a flat sheet of zinc, also horizontal. An electrical connection is formed between the guard-plate and suspended disk by a bridge of very fine wire. The method of using the apparatus to determine the potential required for a spark to pass from a Holtz machine through varying thicknesses of air was explained. When the balance has been accurately counterpoised an excess weight, say 1 grm., is introduced into the scale-pan, and the guard-plate and the lower attracting-plate, as well as the two knobs of a spark-measurer, are connected with the conductors of the machine. If this be now set in action, and the knobs of the spark-measurer be gradually separated, a point will be reached at which the attraction upon the suspended disk just overcomes the excess weight in the balance-pan. The length of spark for which this occurs can now be read off. The difference of the potential causing the spark is given by the formula—

$$\frac{e}{a}\sqrt{8F},$$

where a is the radius of the attracted disk, e its distance from the attracting-plate, and F the force of attraction in dynes. In the apparatus exhibited a had the value 5·195 c.m., and e the value 2·4 c.m., whence if w be the excess weight in grammes—so that $F = 981\ w$—the difference of potential becomes $39\sqrt{w}$. The proper action of the apparatus depends essentially upon the attracted disk being accurately in the same place with the guard-plate. To facilitate this adjustment each of the silk fibres by which the disk is suspended is attached to a screw, by which it can be separately raised or lowered; and by means of another screw the small brass plate holding the suspending screws can be raised or lowered as a whole. A few numerical results were given to illustrate the action of the apparatus: these were taken from a set of experiments in which the difference of potential needed to produce sparks in air between two equal brass spheres of 2·61 c.m. radius was measured. The following are the results for a few of the shortest and longest sparks measured:—

Length of Spark.	Difference of Potential.	Mean Electrical Force.
0·1325 c.m.	17·4	131·0
0·1825 ,,	20·4	117·0
0·2370 ,,	24·6	104·0
·.	·.	·.
·.	·.	·.
0·6800 ,,	62·9	93·0
0·7100 ,,	65·2	92·0
0·740 ,,	68·7	93·0

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

October 29, 1877.

Professor C. LIEBERMANN, Vice-President, in the Chair.

THE following communications were presented:—

C. RAMMELSBERG, "*Atomic Weight of Molybdenum, and Composition of the Phospho-Molybdates.*" By reduction of molybdic acid in H, the author obtains the atomic weight Mo = 96, coinciding with Berzelius's determinations, and in opposition to the number 92, used by Fresenius and most analysts at present. In order to settle the vexed question with regard to the structure of the ammonium phospho-molybdate used in the determination of phosphoric acid, he carried out a number of analyses, not only of this salt, but of the corresponding potassium salt. The average of the results led to the following molecular relations:—

	R_2O.	P_2O_5.	MoO_3.	H_2O.
Ammonium salt ..	9·98	1	21·9	11·7
Potassium salt ..	2·80	1	22·2	11·7
Or	3·00	1	22·0	12·0

viz., $3R_2O + P_2O_5 + 22MoO_3 + 12$ aq. The colourless salt obtained from ammonium molybdate, phosphoric acid, and excess of ammonia, was found to possess the composition $3Am_2O + P_2O_5 + 5MoO_3 + 7$aq, while the corresponding white potassium salt formed on addition of HKO to the yellow phospho-molybdate was $5K_2O + P_2O_5 + 15MoO_3$. A salt corresponding to the colourless ammonium salt was obtained by melting $1K_2CO_3$ with $2MoO_3$, and adding P_2O_5 to the solution; and a white salt,—

$$5K_2O + 2P_2O + 510MoO_3 + 20aq,$$

formed by adding a small amount of HKO and P_2O_5 to $K_2Mo_3O_{11}$.

"*Estimation of Cuprous Oxide in Copper.*" The proposal of Hampe to determine the Cu_2O in crude copper by treatment with a solution of AgN_3 is regarded as unreliable by the following test:—A weighed amount of Cu_2O was digested with an excess of $AgNO_3$. The filtrate contained then 28·8 per cent of the Cu, while the remainder was precipitated with Ag in the form of a baric nitrate, $3Cu(NO_3)_2 + 7CuO$, the reaction being—

$$7Cu_2O + 14AgNO_3 - 14Ag + 4Cu(NO_3)_2 + Cu_{10}N_6O_{25}.$$

H. WICHELHAUS defends his position with regard to the "*Formation of Quin-hydrone,*" in connection with Liebermann's late researches (CHEMICAL NEWS, vol. xxxvi., page 51).

R. SCHIFF and G. TASSINARI, "*Ammoniacal Derivatives of the Chlorals.*" Butyl-chloral-ammoniac and acetic anhydride, as well as butyl-chloral and acetamide, yield the same acetyl-butyl-chloral-ammoniac,—

$$CCl_3.CH_2.CH_2.COHH.NH.C_2H_3O,$$

insoluble, snowy white crystals, melting at 158°. These results, coinciding with those in the ethylic series, show that the addition-products of the chlorals and acid-amides are identical with the compounds obtained by introducing acid radicals into the amide group of the corresponding chloral ammoniac. It is further ascertained that the bromals possess this property in common with the chlorals. The reaction-products of aldehyds and chloral-ammoniac gave no satisfactory results.

E. DEMOLE, "*Tartronic Acid.*" This acid is prepared easily by heating dinitro-tartaric acid with dilute alcohol, and allowing to cool on the cessation of the formation of gases. The reaction is—

$$(CH.ONO_2)_2(COOH)_2 - CO_2 + N_2O_3 + CH.OH(COOH)_2.$$

"*Etherification by means of Hydrochloric Acid at Low Temperatures.*" The reactions between acetic acid and ethylic or amylic alcohol can be carried out perfectly at 0°. At this temperature acetyl chloride is likewise formed when HCl is led through a mixture of phosphoric anhydride and acetic acid. Hence the author judges that in

etherification at low temperatures by means of HCl the acid chloride is first formed, which then gives with the alcohol the desired ether.

G. NEUHÖFFER and G. SCHULTZ, "*Action of Amines on Chlorinated Quinons.*" After recounting the literature of quinon-amines, the authors describe the reactions with trichloro-quinon. The alcoholic solution forms with aniline, toluydin, benzidin, naphthylamine, &c., precipitates which dissolve in concentrated H_2SO_4, yielding bright blue solutions. The aniline derivative has been examined and found to be dianilido-mono-chloro-quinon.

C. WURSTER, "*The Sizing of Paper.*" This operation is at present chiefly carried out by means of a mixture of alum and resin-soap, *i.e.*, sodium salts of the various acids in colophonium, the sizing being regarded as due to the alumina salts of these acids, which are thereby formed. The author finds from analyses of sized paper that, on the contrary, the sizing is due to uncombined resin, and that the resin can be obtained in a state of suspension in water where the particles are so fine that they pass through filter-paper, which is admirably adapted for sizing, possessing remarkable anti-capillary properties. Successful sizing depends on dissolving the colophonium in such a manner that by dilution the resin is not precipitated in flocculent masses, but forms a milky liquid. Paper treated with this preparation is sized towards water and weak acids, dut not towards alkalies or other liquids dissolving resin. The ink used should therefore be slightly acid.

R. ANSCHÜTZ and G. SCHULTZ describe a convenient "*Apparatus for Determining Fusing-points.*" It consists of a small rounded flask, into the neck of which is melted a test-tube reaching nearly to the bottom of the fiask. A tubulus on the side communicates with the air, and is occupied by a long narrow tube when the apparatus is heated, and by a chloride of calcium tube when not used. The interior is filled to the half with sulphuric acid or paraffin. The capillary tubes containing the substances with the thermometer are placed in the test-tube on a pad of asbestos, and the apparatus slowly heated. The advantages are—reliability of results in consequence of the rapid equalisation of the temperature in the test-tube, and freedom from unpleasant vapours when determining high melting-points.

"*Action of Sodium on Halogen Anilines.*" In the ortho, meta, and para series this reaction gives rise exclusively to azo-benzene. The authors considered that this result was due to the formation of the intermediate C_6H_5NHNa, which was oxidised by the air to $C_{12}H_{10}N_2$ and NaOH, and found, in fact, that azo-benzene was formed by passing a stream of air through an ethereal solution of C_6H_5NHK.

J. BÖHM, "*Formation of Starch in the Leaves of the Scarlet Runner.*" The experiments adduced show in opposition to the hitherto accepted theory of the formation of the starch in the chlorophyll cells, resulting entirely from the direct assimilation of CO_2 and H_2O in sunlight, that in the case of the scarlet runner, when the leaves are deprived of light, the starch disappears entirely from the cells, but is replaced in the course of a few weeks by contributions of starch from cells in other parts of the plant exposed to the sunshine.

H. VOHL describes a simple "*Apparatus for the Determination of the Acetic Acid in Vinegar,*" consisting of a flask provided with a $CaCl_2$ tube, and closed by a caoutchouc stopper, through which passes a glass rod terminating in a platinum hook, and supporting a tube of sodic bicarbonate. The apparatus is weighed alone, the vinegar added, and after weighing the bicarbonate lowered into the liquid. The resultant CO_2 is removed entirely by suction, and the final weighing takes place.

"*Determination of the Impurities of River- and Spring-Water.*" For the purpose of examining the impurities in the Rhine, the author makes use of the boiler incrustations and boiler residues of the steamers on the river. Arsenic, H_2S, and a variety of other poisonous and injurious compounds were detected, while the large percentage of phosphorie acid showed that the Rhine was bearing to the sea enormous quantities of valuable fertilising matter. In tests for impurities resulting from the propinquity of gas-works, it must be borne in mind that by filtration through the earth the liquid refuse from the manufacture of gas loses its $S(NH_4)_2$, and empyreumatic constituents entirely, while quantities of magnesia are dissolved from the soil, and the ammoniac is partially changed into HNO_2. The analyst must notice particularly, then, the amount of NH_3, an unusually high percentage of MgO and HNO_2, and the presence of hyposulphurous acid.

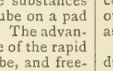
G. GÖTTIG obtains "*The Salicylic Ether of Glycerin,*" $C_6H_4.OH.CO.OC_3H_5(OH)_2$, by passing HCl through a saturated solution of salicylic acid in glycerin at 100°. It is a colourless odourless liquid, giving a violet colour with Fe_2Cl_6.

A. NAUMANN continues his observations on the "*Distillation of Liquids by means of Steam*" (CHEM. NEWS, xxxvi., 212), and finds that turpentine oil (boiling at 160°) is distilled in this manner at 94° in a mixture containing 42 per cent H_2O, and that CCl_4 (boiling at 76°) is distilled at 66°, the distillate containing 6 per cent H_2O.

E. SCHUNCK and H. RŒMER has obtained several derivatives of "*Flavo-purpurin,*" showing its non-identity with the isomeric iso-purpurin. Diacetyl, triacetyl, and dibenzoyl compounds are described. Bromine gives rise to tribromo-flavo-purpurin, $C_{14}H_5Br_3O_5$. Purpurin forms a mono-bromo- and iso-purpurin a dibromo-compound.

G. LUNGE and F. SALATHE have determined the "*Amount of Sulphuric Anhydride formed in Roasting Iron Pyrites*" by conducting the resultant vapours through a normal iodine solution, in which the amount of SO_2 oxidised to SO_3 is ascertained by titration, and the total amount of SO_3 determined as $BaSO_4$. This method was found to be the only satisfactory one by which the two oxidation-products of S could be determined alongside each other. Experiments with pyrites showed that 18 per cent of the S is changed into SO_3 when the gases pass over a layer of heated Fe_2O_3, while but 6 per cent appears as SO_3 when the Fe_2O_3 is absent.

W. STAEDEL prepares "*Chlor-acetyl-benzene*" by conducting Cl through the vapours of acetophenon. 300 grms. of the latter yielded 250 grms. of $C_6H_5.CO.CH_2Cl$, the melting-point of which is found to be 58°. By the action of ammonia on chloracetyl-benzene the author obtains small quantities of "*Iso-indol,*" which possesses the composition of the indol derived from indigo, and apparently an analogous structure. Its formation results from the loss of water by the amide, $C_6H_5.COCH_2.NH_2$, derived from chloracetyl-benzene. The various reactions point to the structure—



which if true would make it a member of the meta-nitriles, a class as yet embracing but two or three representatives.

H. PRÆTORIUS obtains by the "*Action of Fuming Nitric Acid on Benzo-phenon,*" or benz-hydrol, two new dinitro-benzo-phenons, melting at 148° and 189°, making the total number three.

C. BECK, "*Dioxy-diphenyl-methan.*" This new phenol, $CH_2(C_6H_4OH)_2$, is obtained from diphenyl-methan, and forms a yellowish white powder. Sodium salts, methyl and ethyl ethers, acetate and benzoate, are described. Br yields a tetra-bromo-dioxy-diphenyl-methan. Chromic anhydride oxidises the ethyl-ether to diethoxyl-benzophenon, $CO.(C_6H_4.O.C_2H_5)_2$, while the phenol itself is changed by fusion with HKO into C_6H_5OH and paroxy-benzoic acid.

A. ATTERBERG and O. WIDMAN, "*New Chloro-naphthalins.*" The authors have applied their processes of exchanging NO_2 groups for Cl by means of PCl_5, and of introducing Cl into the naphthalen group by submitting additive compounds with Cl to the action of alcoholic HKO. γ-Dichloro-naphthalen, exposed to the action of

Cl in a CCl_3H solution, yields γ-dichloro-naphthalen-tetrachloride, and trichloro-naphthalen-dichloride,—

$$C_{10}H_5Cl_3.Cl_2.$$

This latter yields, with HKO, δ-tetrachloro-naphthalen, the nitro-derivative of which gives, with PCl_5, β-tentachloro-naphthalen, $C_{10}H_3Cl_5$. Oxidation changes this into trichloro-phthalic acid. A fifth tetra-chloro-naphthalen (ε) arises from the action of PCl_5 on dinitro-γ-dichloro-naphthalen.

H. Brunner and R. Brandenburg, "*Methyl-Violet.*" The authors obtain this dye by the action of bromine on dimethyl-aniline, in the form of a tetramethyl-rosaniline-tetra-hydrobromate,—

$$3C_6H_5N(CH_3)_2+3Br_2=2HBr+C_{20}H_{15}(CH_3)_4N_3.4HBr.$$

It dyes a handsome blue-violet, colouring perfectly ten times its weight of silk. By heating the HBr is gradually lost, and redder shades are obtained. A handsome blue-green resulted from heating together 3 mols. dimethyl-aniline, 3 mols. benzyl-chloride, and $2Br_2$, at 120°. Blue dyes were obtained by introducing but 1 or 2 mols. of benzyl.

"*Diphenylamine Blue.*" This is prepared as follows :—

$$2(C_6H_5)_2NH+2NH_2.C_6H_4.CH_3+6Br=$$
$$=NH_3+6HBr+C_{26}H_{17}(C_6H_5)_2N_3.$$

The purified substance is almost insoluble in water; it yields, however, a sulphonic acid with soluble salts, which impart a deep blue.

R. Maly obtains "*Sulphydantoic Acid,*"—

$$CS(NH_2)NH.CH_2.CO_2H,$$

by adding ammonia to a gently-warmed mixture of sulphourea and monochlor-acetic acid, and digesting for a few hours. It is soluble in small quantities in hot water, and forms no stable salts.

A. Friedel, J. Crafts, and E. Ador describe a "*Synthetic Preparation of Benzoic Acid and Benzophenon,*" by the action of $COCl_2$ on C_6H_6 in the presence of aluminium chloride. The chief product is $CO(C_6H_5)_2$, which can be prepared technically according to this method. The C_6H_5COCl which is formed is chiefly changed, by contact with benzene, into $(C_6H_5)_2CO$ and HCl.

R. J. Friswell and A. J. Greenaway, "*Thallium-platinum Cyanide.*" The authors prepare this salt, which is colourless, as follows :—

$$Tl_2CO_3+H_2PtCy_4=Tl_2PtCy_4+CO_2+H_2O.$$

By doubling the amount of Tl_2CO_3 the salt—

$$Tl_2PtCy_4.Tl_2CO_3,$$

crystallising in red needles, is obtained. Carstanjen has wrongly regarded this compound as the simple cyanide.

Chichester A. Bell, "*Pyrrol Derivatives.*" The mono-methyl, ethyl, and amyl derivatives have been obtained by the distillation of the corresponding monamines of mucic acid, and are accompanied by small quantities of dimethyl-, diethyl-, and diamyl-carbopyrrol-amid, as well as substituted carbo-pyrrolic acids.

P. Griess describes his preparation of "*Ortho-azo-benzoic Acid,*" and shows, in opposition to the statements of Claus and Fittica, that in its properties and those of its salts it is strikingly different from the para and meta acids.

H. Schröder, "*Simple Relations between the Volumes of Organic Silver Salts.*" These volumes are all multiples of 5·14, the volume unit of silver, differences of CH_3 in the normal series, corresponding to $3\times5{\cdot}14=15{\cdot}4$. For example :—

$$C_2H_3AgO_2=10\times5{\cdot}14=51{\cdot}4.$$
$$C_3H_5AgO_2=13\times5{\cdot}14=66{\cdot}8.$$
$$C_4H_7AgO_2=16\times5{\cdot}14=82{\cdot}2, \text{ &c.}$$
$$C_6H_5COOAg=20\times5{\cdot}14=102{\cdot}8.$$

P. v. Lepel detects the "*Colouration of Wine with the Juice of the Red Beet-root,*" through the spectroscopic reaction. The solution in wine yields two prominent absorption-bands, α having its maximum between D and E, and β having its maximum close to F. The spectra formed on the addition of $CuSO_4$ and alkalies are also given.

H. Klinger, "*Thialdehyds.*" Stilbene, $(C_6H_5)_2{\cdot}C_2H_4$, is easily prepared in quantities from the amorphous α-benzo-thialdehyd by first changing the latter, through the action of small quantities of I, into the isomeric β-benzo-thialdehyd, and then heating with twelve times the amount of powdered Cu. The trimolecular acethi-aldehyd, $(CH_3.CHS)_3$, forms, like the normal sulphides, trimethyl-sulphinic iodide on heating with CH_3I.

"*Action of Methylic Iodide on Sulphur.*" The reaction gives trimethyl-sulphinic iodide, $(CH_3)_3SI$, which forms double salts with $PtCl_4$ and $AuCl_3$.

R. Anschütz, "*Action of Acetyl-chloride and Acetic Anhydride on Dibasic Acids.*" Acetyl-chloride is without effect except with camphor acid, the anhydride of which is formed. Acetic anhydride gives rise to the formation of the anhydrides of dibasic acids, as follows :—

$$R''(COOH)_2+(CH_3CO)_2O=R''(CO)_2O+2CH_3COOH.$$

In this manner diphenic, succinic, phthalic, and camphoric anhydrides were prepared. Acetic anhydride yielded, with dibromo-succinic acid, mono-bromo-maleic anhydride, which formed iso-bromo-maleic acid by the action of BrH. Succinic anhydride was obtained by the action of succinic chloride on succinic acid, and benzoic anhydride by the action of benzoyl chloride on oxalic acid.

A. Pinner and F. Klein, "*Transformation of Nitriles into Imides.*" The authors describe a new and general reaction for the preparation of a new class of bodies termed "imido-ethers." It consists in the action of dry HCl on mixtures of equivalents of nitriles (CH_3CN, C_2H_5CN, &c.) with alcohols, chlorals, aldehyds, and organic acids. The reaction with benzo-nitrile and isobutyl alcohol has been studied more particularly. The entire mixture has been changed into a mass of crystals, the reaction being —

$$C_6H_5CN+C_4H_9OH+2HCl=C_6H_5C\begin{cases}NH_2\\OC_4H_9.HCl\\Cl.\end{cases}$$

By treatment with NH_3 the compound yields benzimido amide hydrochlorate,—

$$C_6H_5C\begin{cases}NH\\NH_2\end{cases}HCl,$$

and benzimido-isobutyl ether,—

$$C_6H_5C\begin{cases}NH\\OC_4H_9.\end{cases}$$

NOTICES OF BOOKS.

Agendas Dunod. No. 4, *Arts et Manufactures, Chemie.* Paris : 1877.

The introduction to the last issue of this little book contains a striking exemplification of the vitality of a lie long after it has been proved to be what it is, and when everyone who has been concerned in its refutation had thought it was dead and buried. In a chapter on the spectroscope, a very meagre and old-fashioned one by the way, which has been extracted from MM. Boutan and d'Almeida's "Cours Elémentaire de Physique" in order to puff that work, the following passage occurs *àpropos* of the discovery of the metal thallium :—"Plus tard, au mois de Mai, 1862, M. Lamy arrive par l'emploi de la même méthode, a l'erolement d'un troisième métal le *thallium*, qu'il a pu extraire en quantités assez considérables des bones des chambres de plomb recueillies dans une usine on l'on prépare l'acide sulfurique pas la combustion des pyrites de fer. Avant lui, M. Crookes avait aperçu il est vrai la

raie characteristique du thallium, en operant sur les résidues de certains seleniums, *mais il n'avait pu l'isoler et considerant même ce corps comme un metalloïde analogue au selenium et au tellure.*" The italics are our own. This gross misstatement of the facts of the case is precisely similar to that made by M. Dumas in his report to the French Academy of Sciences (*Comptes Rendus*, lv., p. 866, Dec. 15, 1862) nearly fifteen years ago, and fully refuted by Mr. Crookes in the *Phil. Mag.* for July, 1863 (4th series, vol. xxvi.)

The over-zealous action of M. Lamy's injudicious friends was greatly blamed at the time, and the refutation of his misstatements was endorsed by all the leading scientific men of that day. In spite of all this, however, MM. Boutan and d'Almeida have continued to publish the paragraphs we have noticed in every successive edition of their "Cours de Physique" issued since 1863, the last being the fourth. MM. Boutan and d'Almeida seem to be particularly chary of allowing foreign chemists and physicists their proper due, for although M. Janssen's discovery of a method of examining the solar protuberances at any time when the sun is above the horizon is mentioned, the fact that Mr. J. Norman Lockyer made the same discovery quite independently is utterly ignored, notwithstanding that M. Janssen himself was the first to acknowledge that Mr. Lockyer was entitled to as much credit as himself.

While on this subject we regret to say that in the last edition of Mrs. Somerville's "Physical Geography," just published by Mr. Murray, the discovery of thallium is placed to the credit of M. Lamy alone. For an English edition to make such a blunder is unpardonable.

The rest of the "Agenda" is made up of extracts from works published by M. Dunod, interspersed with some really valuable tables. There is also a diary appended, which will be found useful. The book is published in Paris for the low price of one franc: we cannot, therefore, quarrel with M. Dunod for strewing it with advertisements which crop up in unexpected places. Had a little more care been exercised by the editor of the book we should not meet with such misprints as *fuschine*, nepeuthes, xantium, Bunzen, Kirchoff, &c. Sydney Smith said it would require a surgical operation to get a joke into the heads of some people; it would require many to make a Frenchman spell foreign words and names with any approach to correctness. We are bound to say, however, that these blunders do not seem to extend to the tables, which as far as we have examined them are correct. Being a French scientific book it is almost needless to say that it is without an index.

The Chemistry of the Brewing-Room, &c., with Tables of Alcohol-Extract and Original Gravity. By CHARLES H. PIESSE, F.C.S. London: Trübner and Co., Ludgate Hill. 1877.

THIS little work contains the substance of a course of lectures delivered by the author to several classes of practical brewers, and claims to teach all the chemistry that it is needful for a practical brewer to know. The work begins with a chapter explaining the various chemical terms used in the lessons, and describing the necessary apparatus for carrying out the experiments. The general examination of worts and beers is next treated of, the processes for the determination of the amount of saccharine extract, alcohol, ash, and chlorine in the ash being described at length. The estimation of alcohol in beers is next described, copious tables showing the specific gravity of certain percentages of water and alcohol, both by weight and volume, and their equivalent in percentages of proof-spirit. A special chapter is devoted to the difficult subject of the determination of the original gravity, or the specific gravity of the wort before fermentation, the drawback allowed by the Excise on exported beers being calculated on these data, and not on the alcoholic strength of the beer at the time of shipment. Water analysis receives a large amount of attention, processes for the estimation of the nitrates, nitrites, chlorine, total solids, and permanent hardness being given. The Appendix contains a number of tables and useful hints. As an introduction to the study of chemistry of brewing Mr. Piesse's little book may be recommended.

The Spectroscope and its Work. By RICHARD A. PROCTOR. London: Society for Promoting Christian Knowledge. 1877.

THIS little book forms one of a series of Manuals of Elementary Science now in course of publication by the Society for Promoting Christian Knowledge. The strides which Spectroscopy is making daily necessarily causes well-known works on the subject to become prematurely old: we are not therefore greatly surprised to find that a notable number of new discoveries and instruments are described by Mr. Proctor, for which we should look in vain in the standard works of Lockyer, Schellen, Huggins, Roscoe, and others. Beginning with the analysis of light and the solar spectrum, Mr. Proctor leads his reader through the discoveries of Wollaston, Frauenhofer, Brewster, Miller, Stokes, and others, down to the detection of rubidium and cæsium by Bunsen and Kirchhoff. The constituents of the sun's atmosphere and corona are then described, the reasons why they cause dark lines on the spectrum being clearly explained. The next chapter is devoted to an account of the spectra of the stars and other celestial objects, the different forms of star-spectroscopes being fully described and illustrated.

The atmospheric lines in the solar spectrum, as well as those of the atmospheric phenomena such as lightning and the aurora, next receive attention, and are followed by a capital chapter on the very difficult subject of the measurement of the motions of recession and approach of the heavenly bodies, explained with the author's usual lucidity. The little book is a truly wonderful shilling's worth. It contains 128 pp. of closely but clearly printed matter, illustrated by more than seventy woodcuts. There is also a chromo-lithograph of 14 different spectra as a frontispiece. The information in the work is brought down to the very moment of publication by the addition of several addenda containing the latest discoveries in spectroscopy. Unfortunately the book was issued only just before the news of Professor Clarke's capital discovery of the existence of oxygen in the sun's atmosphere.

Butter, its Analysis and Adulterations, specially treating on the Detection and Determination of Foreign Fats. By OTTO HEHNER and ARTHUR ANGELL. Second Edition. London: J. and A. Churchill.

METHODS for the determination of superfluous water or excessive salt in butter are undeniably useful; but in these days, when animal fats are not merely mixed with the produce of the dairy, but even take its place altogether, something more is urgently needed. This important want Messrs. Hehner and Angell have endeavoured to supply. Their method is founded on the principle that the fatty acids of butter are of two different classes, the so-called insoluble, which form about 87·5 per cent of the butter-fat, and the soluble—so-called because they dissolve more or less easily in water—or volatile, which amount to 6 to 7 per cent. If, therefore, butter is adulterated with a fat containing no volatile fatty acids, or a smaller proportion than is found in genuine butter, the percentage of the latter will suffer a corresponding reduction. To render this method trustworthy it must first be shown that the amount of volatile acids in genuine butters is approximately constant. The analysis of Bromeis, which has been very generally quoted or depended upon, makes the total of these acids only about one-fourth part of the pro-

portion given by our authors, but there are certain reasons for supposing that his determinations are not absolutely trustworthy. Thus the substance which he pronounced margarin has been said to have retained volatile acids. Mr. Wanklyn appears to doubt whether these soluble or volatile acids are really present as such in butter, or are rather produced by the action of the alkali employed for saponification, upon the higher fatty acids. For such a supposition the authors consider there is no valid reason, though they admit that butyric acid does not exist in butter-fat as butyrate of glycerin. If, then, we assume as proved the relatively large and constant quantity of volatile acids present in butter, and admit that the substances selected as sophistications will contain a very much smaller proportion of such volatile acids, the author's process must be regarded as rational and feasible. In practice Messrs. Hehner and Angell determine experimentally not the "soluble" or "volatile" acids, but the "insoluble" or fixed. If their amount exceeds 87·5 per cent upon the total fatty matters the case becomes suspicious, though it is scarcely judicious to pronounce a sample adulterated if the insoluble fatty acids do not exceed 88·5 per cent. Still the authors consider that "about 15 per cent of foreign animal fat may be added to a butter rich in soluble acids," the product being then equal to genuine butter of the lowest quality. They mention one fat, cocoa-nut oil, which contains a relative amount of soluble acids equal to that of butter, and which therefore, if used as an adulterant, could not be detected by their process. We scarcely think, however, that this oil is likely to be largely used for such a purpose.

The specific gravity of butters may, in the opinion of the authors, be used as an auxiliary test. In a series of experiments performed by Mr. Bell the specific gravity of butter-fat was found to range between 911 and 913, rarely falling below 910. On the other hand, the specific gravity of ordinary fats varied from 902·83 to 904·56. The experiments were performed at 100° F. (=37·8° C.), which the authors think far too low to be convenient.

The microscopic examination of butter and the determination of the melting-point Messrs. Hehner and Angell do not consider as conclusive.

CORRESPONDENCE.

MARBELLA IRON ORE.

To the Editor of the Chemical News.

SIR,—About a year since I published a series of analyses of iron ores, &c., used in the Scottish iron manufacture, and, among the magnetic ores, I accidentally gave as Marbella ore the analysis of a mineral obtained some miles from Marbella, and differing from the ordinary ore in containing a considerable quantity of combined water. My attention having been called to the error, I have to ask you to do me the favour of giving the following, which may be considered a typical analysis of Marbella ore of the best quality as imported into this country:—

Peroxide of iron	61·00
Protoxide of iron..	25·20
Magnesia	1·70
Alumina	3·56
Silica	7·84
Combined water	0·28
	99·58
Iron	62·30

The ore usually contains traces of lime, oxide of manganese, and bisulphide of iron, and an almost inappreciable trace of phosphoric acid.—I am, &c.,

WILLIAM WALLACE.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 20, November 12, 1877.

Observations on the Principle of Maximum Work and on the Spontaneous Decomposition of Hydrated Binoxide of Barium.—M. Berthelot.—The stability of anhydrous peroxide of barium appears from the following figures. A sample prepared in January, 1874, contained at the moment of its preparation 9·4 per cent of oxygen in excess above what is found in baryta. In November, 1877, there was found 9·2 per cent. It is different with the hydrate $BaO_2,7HO$. This compound, prepared in a state of great purity and preserved moist, as obtained by precipitation and pressure, is gradually decomposed. Gaseous bubbles form in the mass with slight intermittent projections; the oxygen accumulates in well-stoppered bottles, so as to occasion a considerable pressure, which would in time doubtless burst the vessels. At the same time there are formed in the mass crystalline and compact clots of the hydrate $BaO,10HO$. If baric peroxide is preserved under a layer of water the decomposition and the evolution of oxygen are much more rapid. In some samples prepared in January, 1874, the excess of oxygen, by November, 1877, was found to have fallen from 8 per cent to 6·5 and 6·1, about one-fifth of the peroxide having become decomposed. This decomposition had been retarded by the formation of the crystalline hydrate of baryta, which requires 10 equivs. of water, and therefore tends to dehydrate the neighbouring portions of peroxide, which only contains 7 equivs. of water. The portions of peroxide thus dehydrated remain imprisoned in the hydrate of baryta formed simultaneously. If these causes of the arrest or of the retardation of the process are avoided by the presence of a sufficient excess of water, the spontaneous decomposition is much more rapid. In a portion of the same preparation which had been preserved in a bottle under a layer of water the proportion of oxygen had fallen from 8 per cent to 0·28. No carbonate of baryta had been formed, which of course excludes the intervention of the atmospheric carbonic acid. These phenomena might be foreseen on the principle of maximum work, since the decomposition of anhydrous baric peroxide absorbs heat, $BaO_2 = BaO + O$: absorbs $-6{\cdot}05$. Consequently this decomposition cannot take place without the intervention of extraneous energy, borrowed in the act of heating. On the contrary the transformation of baric peroxide into the monohydrate of baryta and free oxygen liberates heat. $BaO_2 + HO = BaO,HO + O$: $+2{\cdot}0$ cal. 76 liquid water $+ 2{\cdot}0$ solid water, a relation which explains the direct displacement of oxygen by gaseous water, as observed by Boussingault. In this latter condition where the physical state of the two bodies which replace each other is the same, the heat liberated rises to $+7{\cdot}6$. In the same manner in the higher hydrates, $BaO_2,7HO + 3HO = BaO,10HO + O$: $+5{\cdot}3$ cal. liquid water $+3{\cdot}2$ solid water. This last reaction is so much the more easy, as the monohydrate of baryta when once formed retains its water even at dull redness; whilst the hydrated peroxide of barium loses all its water in a vacuum without giving off a sensible amount of oxygen if the operation is sufficiently rapid. Thus the transformation of the hydrated peroxide takes place spontaneously at an ordinary temperature. It is effected more rapidly in presence of a proportion of water capable of dissolving the hydrate of baryta as formed, so as to permit the reaction to go on. The pure hydrate of peroxide of barium is transformed more slowly, as each molecule of crystalline hydrate of baryta borrows for its formation a certain proportion of water from the adjacent molecules

of peroxide, $10(BaO_2,7HO) - 7(BaO,10HO) + 7O + 3BaO_2$ liberates: +9·5. The peroxide thus dehydrated remains unless an excess of water contained in the mass does not gradually reach it by infiltration through the crystalline hydrate of baryta with which it is surrounded.

Limits of Etherification.—M. Berthelot.—Reserved for insertion in full.

Quantities of Heat Evolved from Mixtures of Sulphuric Acid and Water.—E. Maumené.—According to the author sulphuric acid recently heated does not liberate the same amount of acid with water as an identical acid which has been preserved for some months. This phenomenon seems to him to introduce into thermochemical researches a source of error of which no account has been taken.

Bulletin de la Societe Chimique de Paris,
Nos. 8 and 9, November 5, 1877.

Quercetagetin, the Yellow Colouring-Matter of the Flower of Tagetes Patula.—MM, Latour and Magnier de la Source.—This compound approaches very closely to quercetin. It is extracted from the flowers of *Tagetes patula* by a long and tedious process, and when perfectly pure has the composition—

C	58·50
H	3·97
O	37·53

answering to the formula $C_{27}H_{22}O_{13}$. Its reactions in solution are identical with those of quercetin as obtained from the decomposition of quercetrin. The crystalline form of the two products is different, the solubility in boiling alcohol of 60 per cent is not the same, and whilst quercetin does not crystallise in alcohol at 85 per cent, quercetagetin is deposited in the form of well-defined felted crystals.

Diatomic Phenol of Xylen.—Ch. Gundelach.—The author examines the iso-chlor-oxylen sulphite of potassa and its behaviour with potassa in fusion.

Volatilisation of Liquids in Gases.—W. Kirchman.—The author has observed that the evaporation of certain volatile bodies is retarded or hindered in an atmosphere of carbonic acid, whilst the volatilisation of other compounds is augmented. Camphor is scarcely volatilised at all in carbonic acid, as is also the case with bisulphide of carbon, chloroform, &c. Ether, methylic, ethylic, and amylic alcohols, and also water are more volatile in carbonic acid than in air. Dry carbonic acid is an excellent means for freeing essential oils from water.—*Archiv. fur Pharmacie.*

Industrial Treatment of Lepidolite for the Extraction of Lithium, Cæsium, and Rubidium.—H. Peterson.—Lepidolite contains very considerable quantities of alumina, which the author proposes to utilise. Its composition is:—

Alumina	28·54
Silica	50·39
Ferric oxide	0·73
Alkaline earths	1·52
Alkalies	16·00
Water	2 to 3

The mineral is melted in a reverberatory, suddenly chilled, and pulverised. It is then treated with an equal weight of monohydrated sulphuric acid in a vat lined with lead, and heated with a current of steam. The paste produced is then drawn off before it solidifies, and allowed to stand for twenty-four hours. An excess of water is then added, and the whole is then boiled, filtered at a boil in a leaden filter-press, or else allowed to settle and decanted without growing cold. The liquid is concentrated to 40° B. in leaden boilers heated by steam, and is then allowed to crystallise. On cooling all the rubidium and the cæsium are deposited as an alum along with a very little potassium. The alums of cæsium and rubidium are separated by a series of crystallisations. The mother-liquors containing the potash alum and an excess of sulphate of alumina and free sulphuric acid are mixed with a cold concentrated solution of carbonate of potash (25 parts of dry carbonate to 100 of chilled lepidolite). The alum is deposited on cooling as a crystalline powder containing mere traces of iron. The mother-liquors of the alum, still acid, are diluted with water, treated with an excess of carbonate of potash to throw down the alumina, filtered, and evaporated to 35° B. Sulphate of potash and a portion of sulphate of soda crystallise out on cooling. The mother-liquors are again digested with powdered carbonate of soda to precipitate lithia. The small quantities of this base still remaining in solution are precipitated with phosphate of soda. The lithic phosphate thus obtained is melted with lime, and the lithia thus liberated is extracted in boiling water. The crude carbonate of lithia precipitated is re-dissolved in boiling water, and causticised with lime. The clear solution, concentrated to 40° B., is then again treated with pure carbonate of soda. Carbonate of lithia is then precipitated in a state of purity, and is washed first with a little water, then with alcohol, and finally dried.—*Dingl. Pol. Journ.*

Printing Cochineal Reds upon Woollen Tissues.—M. Kielmeyer.—The author recommends an addition of acetate of soda to the colour to counteract the effect of the cochineal. He prefers the following mixture:—

Gum	14·0 kilos.
Water	15·0 „
Cochineal lake	17·5 „
Young fustic lake	2·2 „

The mixture is heated to 60°, and when the gum is dissolved there is further added—

Oxalic acid	1·00 kilo.
Pure salt of sorrel	1·75 „
Acetate of soda	2·25 kilos.

He adds that the addition of acetate of soda greatly improves the tone of steam yellows and oranges produced with young fustic. The benefit is still more signal in printing cottons with magenta.—*Dingl. Pol. Journ.*

Biedermann's Central-Blatt fur Agrikultur Chemie,
Heft 10, October, 1877.

Researches on the Cultivation of Moorlands.—Dr. A. Pagel and W. Th. Oswald.—Humate of lime can easily co-exist with free sulphuric acid in peaty soils, and when enclosed in resinous masses it may be totally ineffectual for the decomposition of injurious compounds of iron.

Transformation of the Phosphoric Acid of Mineral Phosphorites and Behaviour of Nitrogenous Compounds in Humous Soils.—Dr. F. Holdefleiss.—Natural humic compounds in the state in which they occur in arable soil and in peat-earth possess the property of decomposing crude phosphorites, if at all, to a very slight extent. The humoid products of the decomposition of farm-yard manure have a scarcely perceptible effect on the decomposition of natural phosphorites. The carbonic acid formed by the decomposition of the organic compounds is likewise incapable of accelerating in any practical degree the natural "weathering" of phosphorites. The organic acids in so-called "acid humus" are likewise incapable of attacking phosphorites. Inorganic salts, especially nitrates, have more effect upon phosphorites than the organic compounds just mentioned. Many peat-soils contain an appreciable amount of sulphuric acid, in consequence of which they render phosphorites soluble. All normal arable soils have the power of converting ammonia almost entirely into nitric acid. The presence of carbonate of lime promotes this transformation to such an extent that in six months far more than half the

absorbed ammonia is nitrified. When the organic substance of peat-earth consumes oxygen the formation of nitric acid may be delayed. Abundant application of potash-manures almost entirely checks the formation of nitric acid.

Experiments on the Production of Plants.—Prof. H. Hoffmann.—The author has been for twenty-two years engaged in experiments on the modification of plants by interference in their external vital conditions. He concludes that the cause of the evolution of new species lies, not, as Darwin believes, in outward influences, but in internal organic laws, whose nature is at present concealed.

Defecation of Sugar-Cane with Magnesia.—C. Bernard.—After neutralising with lime the juice is boiled up with magnesia in the proportion of 3 parts to 4000. It is then passed through Taylor's filter, and mixed with aqueous sulphurous acid till faintly acid; concentrated, crystallised, and dried in a hydro-extractor.

Justus Liebig's Annalen der Chemie,
Band 189, Heft 1 and 2.

Normal Primary Heptyl-Alcohol and Certain of its Derivatives.—C. J. Cross.—The derivatives here described are heptyl-chloride, bromide, iodide, acetate, œnanthylate, and ethyl-heptyl-ether.

Contributions to a Knowledge of the Amidic Acids.—Dr. F. Hofmeister.—The author gives a tabulated view of the behaviour of the amidic acids with reagents, describes the copper salts of leucin, asparagic acid, glutamic acid, and tyrosin; and finally treats of the solvent power of the amidic acids for cupric oxide in alkaline liquids.

On Isodibutylen.—A. Butlerow.—A prolonged memoir not capable of useful abstraction.

Researches on Para-tolyl-phenyl-keton.—W. Thörner.—The author examines the chlorine derivatives of this substance obtained by the action of phosphoric pentachloride or by that of free chlorine gas with the aid of heat, such as para-benzoyl-benzyl chloride, para-benzoyl-benzylen chloride, and para-benzoyl-benzo-trichloride. The second part of the paper treats of the isomeric pinacolines formed by the action of nascent hydrogen upon para-tolyl-phenyl-keton.

Communications from the Chemical Laboratory of the Polytechnic School of Delft.—These communications consist of a paper on "Products of the Decomposition of Phenol at a Red Heat," by Dr. J. G. Kramers; a memoir, by the same author, on the "Products of the Decomposition of Chlorbenzol at a Red Heat; and a third paper, by the same author, on the "Products of the Direct Chloration of Diphenyl.

Contributions to the History of the Naphthalin Derivatives.—J. Stenhouse and C. E. Groves.—An account of nitroso-β-naphthol, of mono-nitro-β-naphthol, and of β-naphtho-quinon.

On Acetylen Urea.—Hugo Schiff.—This compound is obtained by the reaction of 1 part glyoxal and 2 parts of urea dissolved in 3 parts of water, with the addition of a few drops of hydrochloric acid. It contains 34·10 per cent of carbon and 4·40 of hydrogen, and may be represented by the formula $C_4H_6N_4O_2$.

Peculiar Decomposition of Boric Ether.—Hugo Schiff.—About 25 grms. of ethyl borate were placed in a well-stoppered bottle, the thick neck of which becoming accidentally cracked admitted very slowly watery vapour. After the lapse of about two years the edges of the crack were covered with crystalline boric acid, whilst the contents of the bottle were converted into a very hard, almost colourless, transparent, vitreous mass. Two similar portions of ethyl borate preserved in undamaged bottles had undergone no change.

Action of Bromine upon Phloro-glucin.—Rudolf Benedikt.—The author describes the preparation and properties of phloro-bromine, and its behaviour with ammonia and alcohol.

On Certain Derivatives of Uvitic Acid.—Dr. Carl Böttinger.—An account of nitro-uvitic acid, of α-amido-uvitic acid, of α-oxy-uvitic acid, of β-nitro-uvitic acid, of β-amido-uvitic, and β-oxy-uvitic acids.

On Chloride of Iodine, Bromide of Iodine, Chloride of Bromine, and their Behaviour with Water.—W. Bornemann.—Iodine takes up the more chlorine the more water is present. Bromide of iodine is soluble in water without any important decomposition. Chloride of bromine dissolves in water with a yellow colour; the solution retains the odour of chloride of bromine, bleaches litmus, and quickly loses the greatest part of the chloride of bromine on exposure to the air. The author confirms the statement of Schützenberger that pure chloride of iodine in a sealed tube remains liquid in the cold, but congeals on opening. In presence of ICl_3 it crystallises, even in a sealed tube. On the distillation of ICl it is partially resolved into iodine and ICl_3, the same decomposition being also produced on prolonged exposure to the air. Bromide of iodine is a crystalline body of the colour of iodine; it is partially decomposed on distillation, and sublimes in frond-like aggregations of crystals. There does not exist a hydrated bromide of iodine of the formula $BrI+5H_2O$, nor an analogous hydrated chloride of bromine.

Communications from the Laboratory of the University of Halle.—These consist of a paper on "Diacetonamin and Vinyl-diacetonamin (Isotriacetonamin)," and a memoir on the "Action of Hydrocyanic Acid upon Hydrochlorate of Diacetonamin," both by W. Heintz.

Band 189, Heft 3.

Researches on Optical Rotatory Power.—H. Landolt.—(First Treatise: "On the Determination of the Specific Rotatory Power of Active Substances.") When we mention that this first part of the author's researches extends to nearly 100 pages, and comprises illustrations, extensive tables of the results of experiments, &c., it will be evident that we cannot offer anything like a fair abridgment. The author's principal results are:—(1.) The specific rotation of active bodies on increasing dilution with an indifferent liquid undergoes, not sudden, but continuously progressive modifications. Whether these consist of an increase or a decrease depends on the nature of the active body. (2.) From the rotatory power of a number of dilutions that of the pure substance may be calculated, though with a degree of certainty which varies in every case, and which is affected by—(*a*) The magnitude of the changes which the rotatory power undergoes by the admixture of the inactive liquids; (*b*) the manner in which these changes progress with an increasing proportion of the solvent, *i.e.*, whether they can be expressed by a straight line or by curves; (*c*) the concentration of the solutions employed. (3) On calculating the original specific rotation of any substance we obtain always the same value, no matter what indifferent liquid may have served as a solvent.

Reimann's Färber Zeitung,
No. 42, 1877.

This issue contains nothing of general interest.

No. 43, 1877.

According to a sensational story now figuring in the German daily papers, certain wax candles fixed in a chandelier, which had been duly extinguished at the close of an entertainment in the Möckernstrasse, Berlin, contrived to re-ignite themselves in the middle of the night without human intervention. The candles in question, like all dangerous things, were green, and the colour is said to be due to an admixture of finely divided verdigris. The theory devised to account for the alleged phenomenon, and which we need scarcely say is *not* Dr. Reimann's, is that a fine coating of cupric or possibly of cuprous oxide had been deposited on the wick, which, in contact with

carbonaceous matter, absorbed oxygen, evolved heat, and thus re-lighted the candles.

For the hydrosulphurous acid of Schützenberger R. v. Wagner proposes the name hyposulphurous acid and the formula $HOSO$, whilst he gives to the compound $HOSO_2O_2$, formerly known as hyposulphurous acid, the name thio-sulphuric acid.

On purifying large quantities of purpurin, obtained from madder, it was found to be accompanied by a sub-stance of the composition $C_{30}H_8O_{12}$ distinct from all the constituents of madder hitherto known. At 233° it is resolved into purpuroxanthin and carbonic acid, and is hence named purpuroxanthino-carbonic acid.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 10, November 8, 1877.

Means of Preventing the Explosion of Fire-damp in Coal Mines.—M. Basin.—The author recommends ventilation with compressed air, watering the galleries (in dry mines), and the use of Bastie's toughened glass instead of wire-gauze for the cylinders of safety lamps. The tube which gives vent to the products of combustion will contain several superimposed layers of gauze.

No. 11, November 15th, 1877.

According to M. Fano neurosis of the eye has been successfully treated by the use of spectacles with yellow glasses.

M. L. Maiche has been led by a number of experiments to conclude that water is simply hydrogen + electricity, or oxygen − electricity. Or, in other terms, normal hydrogen, if electrised, becomes water, whilst normal oxygen, dis-electrised, also becomes water; hydrogen, oxygen, and water being one and the same thing with a different degree of electrisation.

MISCELLANEOUS.

Butter Analysis.—The prize offered by the Leipzig Pharmaceutical Association for a trustworthy method of butter analysis has been awarded to Otto Hehner, F.C.S., Public Analyst for the Isle of Wight, and Arthur Angell, F.R.M.S., Public Analyst for the County of Hants. As one of the stipulations of the Association, namely, that the successful essay should become its exclusive property, could not be fulfilled by Messrs. Hehner and Angell's method, it having been published some years ago, and as the examiners, Professors Heintz, Knop, and Kohlmann, yet wished to express their appreciation of the method, they presented the authors with the sum of 150 marks. Six essays competed, two from Germany, two from England, one from Austria, and one from Italy.

Owens College Chemical Society.—It is with great pleasure that we call the attention of our readers to the formation of the above Society, which was inaugurated on the evening of Wednesday, the 21st inst. The members of the Society and several old students of the College were entertained by Prof. Roscoe in the College dining hall, after which they adjourned to the Chemical Theatre, where a lecture was delivered by Prof. Thorpe, F.R.S., on "Robert Boyle and the 'Sceptical Chemist.'" The Presidents of the Society are Profs. Roscoe and Schor-lemmer, the Assistant Lecturers on Chemistry at the College acting as Vice-Presidents. Among the honorary members of the Society may be mentioned Prof. Thorpe, Prof. Dittmar, Prof. Atkinson, and Dr. C. R. A. Wright. The following are the subjects to be brought before the Society during the first session:—"Are the 'Elements' Elementary," by M. M. P. Muir, F.R.S.E.; "The Life and Work of Graham," P. P. Bedson, B.Sc.; "Alkali Manufacture," E. J. Bevan; "Berzelius," J. K. Crow, B.Sc.; "Crystallisation," H. Baker; "Liebig," C. F. Cross; "Valency," L. T. O'Shea; "The Chemical Industry of Japan," S. Sugiura. We trust that the example of the students of Owens College will be followed by the students of other provincial colleges.

MEETINGS FOR THE WEEK.

SATURDAY, Dec. 1st.—Physical, 3. "The Telephone," Prof. Graham Bell.

MONDAY, 3rd.—Royal Institution, 2. (General Monthly Meeting). Society of Arts, 8. Cantor Lecture.

WEDNESDAY, 5th.—Society of Arts, 8.

THURSDAY, 6th.—Chemical, 8. "On Gallium," by Prof. Odling. "On the Constitution of the Terpenes and of Camphor," Dr. Armstrong. "On Potable Waters," Dr. Mills.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

OCTOBER, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·000	0·007	0·090	0·043	18·90	8·450	0·210	0·87	1·360	12·6	3·30
West Middlesex	Clear	0·000	0·008	0·090	0·043	19·00	8·560	0·430	0·86	1·300	13·7	3·30
Southwark and Vauxhall	Slightly turbid	0·002	0·010	0·097	0·058	19·50	8·730	0·320	0·87	1·260	13·7	3·70
Chelsea	Clear	0·002	0·009	0·165	0·054	18·10	7·840	0·430	0·87	1·360	13·2	3·70
Lambeth	Slightly turbid	0·000	0·009	0·135	0·047	20·40	9·070	0·430	0·87	1·300	14·8	3·30
Other Companies.												
Kent	Clear	0·000	0·004	0·285	0·010	26·10	10·800	0·720	1·37	2·400	20·0	5·10
New River	Clear	0·000	0·007	0·109	0·018	17·40	8·120	0·320	0·87	1·060	12·6	2·80
East London	Clear	0·000	0·007	0·099	0·040	19·60	8·560	0·360	1·01	1·460	14·3	3·30

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY, M.B.

THE CHEMICAL NEWS.

Vol. XXXVI. No. 941.

DETECTION OF BISMUTH.

Von Kobell's Test.

By W. M. HUTCHINGS.

The mixture of equal parts of potassium iodide and sulphur recommended by Von Kobell for this excellent test has the great disadvantage of being very deliquescent; even if kept in closely-stoppered bottles it sooner or latter becomes pasty, and indeed almost liquid, if the bottles are often opened for use. As it is a great advantage to be able to have such mixtures ready for use, and, where possible, to keep them in little wooden boxes in the portable blowpipe apparatus, I have tried replacing the potassium iodide by cuprous iodide, and have been glad to find that, in addition to the advantage of being non-deliquescent, the mixture so made is in other respects superior for use with the test.

Von Kobell's mixture has another disadvantage, viz., that it itself yields a copious *white* sublimate, the brilliant red sublimate obtained when it is used with a substance containing a good deal of bismuth being caused by the mixture of this white with the dark brownish red given by bismuth iodide alone. When very little bismuth is present and a good deal of the mixture is used, the white frequently overpowers the red almost completely, and when other metals are present which also give white or light-coloured sublimates it greatly assists in concealing the bismuth colour. This disadvantage is also got rid of by using cuprous iodide and sulphur.

The precipitated cuprous iodide is washed free from all trace of potassium salts, dried perfectly, and then ground up to an intimate mixture with an equal volume, or rather more, of flowers of sulphur. This proportion is the best; when less sulphur is used there is more or less white sublimate of cuprous iodide obtained, and also the formation of bismuth iodide is not as copious. For testing pyritous or other sulphide substances, less sulphur, or even none at all, would be required; but it is best to have a mixture which is equally applicable to *all* bismuth combinations. This mixture can be kept rammed tight into little wooden boxes, and is always ready for use. On aluminium plate I find it decidedly more delicate as a reagent than the potassium iodide mixture, using in each case 2 volumes of reagent to 1 volume of the powdered substance to be tested, intimately mixing to a paste and heating gently on a charcoal slip.

The merest trace of the dark brownish red bismuth iodide is very conspicuous on the clean aluminium. The plate should be made pretty hot by blowing the flame upon it some distance above the ledge before commencing to heat the test-mixture, in order to prevent the settling of any sublimate of *iodine*, or any condensation of moisture, which latter destroys the red bismuth sublimate. This precaution is particularly necessary when very little bismuth is present.

On ordinary charcoal or blackened porcelain support the dark-coloured bismuth iodide is not nearly so conspicuous as on aluminium, and does not show as well as the brighter red obtained by using potassium iodide. But a few tests with a substance containing very little bismuth will convince anybody that aluminium plate, with the cuprous iodide mixture, is very much preferable to charcoal and potassium iodide; and I do not think that anyone who has once used aluminium for blowpipe sublimates will ever again use charcoal or porcelain.

Substances containing mercury, when treated with the iodide mixture on aluminium plate, give a sublimate of mercuric iodide, which is partly red and partly yellow, the relative quantities of the two colours varying much in sublimates from the same substance. The red is much lighter and brighter than that obtained from bismuth with the cuprous iodide mixture. It might possibly be taken for the bismuth sublimate mixed with that of lead; but as the number of minerals containing mercury is so limited, and the presence of that metal is so easily proved by other tests, no mistake is likely to arise from this cause.

The value of this test of Von Kobell's is very great; it deserves to rank as one of the best—in some cases the best—test for bismuth. As little as 0·2 or 0·1 per cent can be safely detected by it in many cases, and with great rapidity. In pyritous ores, which fuse to a regulus or in smelted regulus, a considerable amount of bismuth might be present and not be detected by the ordinary sublimate of bismuth oxide, which is frequently very difficult to obtain from such combinations. But a fraction of a per cent can be found by this test without resorting to the wet way.

Substances containing lead give a copious light yellow sublimate when heated with the iodide and sulphur mixture, and when lead is present beyond certain limits this yellow overpowers the bismuth reaction. According to Cornwall (Chemical News, vol. xxvi., p. 150), when lead oxide was mixed with 5 per cent bismuth oxide and tested on charcoal by Von Kobell's mixture, the bismuth could only just be detected, and not with distinctness. But I find that when lead oxide containg only 1 per cent bismuth oxide is tested with the cuprous iodide mixture on aluminium plate a very fine brownish red sublimate is always obtained by heating very gently and observing after a few seconds. Later on the yellow covers this up; but the bismuth iodide always comes off first, and can be seen if observed in time. In all cases sublimates must be allowed to get quite cold before judging them; lead iodide is reddish when hot, but pure light yellow cold.

Cornwall's tests in open glass tubes (Chemical News, vol. xxvi., p. 150) which will detect bismuth when present in such small quantity with lead and antimony that the above method fails, can be better applied with the cuprous iodide mixture than with potassium iodide, and so much sulphur as he recommends (5 volumes) does not require to be added.

These mixtures are also very useful for detecting lead in cases where the ordinary sublimate of the oxide cannot be obtained.

Laboratory, Wallasey Ore Works,
Birkenhead, November 22, 1877.

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.*

By H. CARRINGTON BOLTON, Ph.D.

1. The organic acids have long been used in various operations of chemical analysis, but their direct application to the decomposition of minerals, with a view to the determination of the latter, appears to have been overlooked. Acetic acid finds frequent employment in quantitative analysis; tartaric and citric acids are used to hold ferric and aluminic hydrates in solution in the presence of alkalies, to dissolve antimonic oxide in mineral analysis and in blowpipe tube reactions,† and in the preparation of Fehling's copper solution; ammonium citrate is used to dissolve so-called "reverted" calcium phosphate, and to separate lead sulphate from the sulphates of the alkaline earths; oxalic acid is used to dissolve sulphide of tin in the separation of this metal from antimony,‡ in volumetric analysis, in the determination of the metals

* Read before the New York Academy and Sciences, April 30, 1877.
† Prof. E. J. Chapman, *Canadian Journal*, Sept., 1853, p. 348.
‡ Prof. F. W. Clark, *American Journal of Science*, [2], xlix., 48.

of the magnesium group,* in the valuation of manganese ores, and in many other process.

The behaviour of minerals with the organic acids named has been only casually studied, and in but few instances; T. Sterry Hunt,† following Karsten, has made use of acetic acid in the proximate analysis of mixtures of calcite, dolomite, and magnesite, and in the separation of limestone and serpentine;‡ J. Lawrence Smith§ has remarked the solubility of anglesite in ammonium citrate; calamine is sometimes distinguished from willemite by its gelatinising with acetic acid;‖ and mineralogists often resort to the comparatively weak acetic acid for the purpose of "cleaning up" minerals associated with the easily soluble calcite. So far as we can learn, no systematic examination of the action of organic acids on minerals has previously been made; yet the field proves to be wide and fertile.

During a mineralogical excursion in the summer of 1876, among the rugged mountains of western North Carolina, the impracticability of transporting liquid mineral acids suggested to the writer an examination of the behaviour of minerals with solutions of citric and tartaric acid, which are capable of being carried in the solid state. Subsequently a few preliminary trials established the fact that our preconceived notions of the weakness of organic acids as respects minerals were erroneous, and led to the investigation recorded in the following pages.

It became necessary at the very outset to collect a considerable number of minerals in a state of great purity and of normal physical condition: our own small collection supplied these in part, but we would have been embarrassed in this research without the kind assistance of Prof. Thomas Egleston, who generously placed the rich treasures of the School of Mines' mineralogical collection at our disposal, and to whom we tender our sincere thanks.

Since the hardness, coherence, and solubility of minerals vary greatly in different specimens of a single species, the behaviour of minerals with acids, whether inorganic or organic, depends in large measure upon the condition of the particular sample under examination. An absolutely thorough investigation, therefore, would embrace the reactions of several specimens of each mineral; as desirable as this would seem to be, it was found that on the whole so laborious an undertaking was superfluous, and for two reasons; first, the decomposing action of the acids on different samples of the same species differs in degree and not in kind; and, secondly, the behaviour of different species nearly related is so similar that the observations made on each serve to mutually control.

2. The following list contains the names of the minerals which were submitted to the action of organic acids, their formulæ as given by Prof. Dana, the condition of the specimens, and the locality of each so far as could be ascertained. Where two or more specimens of a single species are named, they are numbered for convenience of reference in subsequent pages.

Within the groups I., Carbonates; II., Sulphides; III., Oxides; IV., Sundries; V., Silicates, the minerals are given in the order, and with the formulas, which they have in "Dana's System of Mineralogy."

I. CARBONATES.

Mineral.	Formula.	Description.	Locality.
Calcite (1)	$\dot{C}a\ddot{C}$	fine-grained marble	Italy.
,, (2)		transparent crystals....	Bergen, N.J.
Dolomite (1)	$\dot{C}a\ddot{C}+\dot{M}g\ddot{C}$	coarse crystalline.....	Westchester Co., N.Y.
,, (2)		fine granular, with flakes of graphite	Amity, N.Y.
Gurhofite	$2\dot{C}a\ddot{C}+\dot{M}g\ddot{C}$	massive, subtranslucent	Montville, N.J.
Ankerite	$\dot{C}a\ddot{C}+(MgFeMn)\ddot{C}$	crystalline	Nova Scotia.
Magnesite (1)	$\dot{M}g\ddot{C}$	massive	Westchester, Pa.
,, (2)		compact	Piedmont.
Siderite (1)	$\dot{F}e\ddot{C}$	massive	Roxbury, Conn.
,, (2)		massive	Dauphiny, France.
Rhodochrosite	$\dot{M}n\ddot{C}$	massive, pure	Austin, Nev.
Smithsonite	$\dot{Z}n\ddot{C}$	earthy, massive.....	Sterling, N.J.
Witherite	$\dot{B}a\ddot{C}$	granular, massive.....	England.
Strontianite	$\dot{S}r\ddot{C}$	granular	Westphalia.
Cerussite	$\dot{P}b\ddot{C}$	crystalline	Phœnixville, Pa.
Barytocalcite	$\dot{B}a\ddot{C}+\dot{C}a\ddot{C}$	massive and crystalline	Alston Moor, England.
Malachite	$\dot{C}u\ddot{C}+\dot{C}uH$	compact	Russia.
Azurite	$2\dot{C}u\ddot{C}+\dot{C}uH$	massive, earthy	Germany.

(To be continued).

* W. Gow, [illegible] (1877), 1, 240.
† American Journal of Science, [illegible], 150, and xiii, 94. Geol. Canada, 1863, 690.
‡ American Journal of Science, [illegible], xv, 244.
§ "Dana's System Min.," 5th edition, p. 408.

A STUDY OF CYANOGEN COMPOUNDS.

By SAMUEL E. PHILLIPS.

(Concluded from p 240.)

Our present knowledge of cyanides seems to justify a threefold division :—

1. Of simple cyanides, or those conforming to the ordinary types of mineral chemistry.
2. Nitrile-cyanides; an isomeric group of ammonias, where we find the terms "methyl-cyanide" or "aceto-nitrile," $(C_4H_3)H_2N$; ethyl-cyanide or propio-nitrile, $(C_6H_3)H_2N$, &c. These are 2 vol. ammonias, and have the corresponding ammonium forms.
3. Iso-cyanides; another isomeric group of ammonias, which also have their corresponding ammonium forms.

A methyl-cyanide of this class would probably be C_2MeN, an ethyl-cyanide C_2EN. Hence they are called "carbamines;" but as this point of view is new it may be well to give a further elucidation :—

$$EI + KCy = KI \text{ and } ECy = \text{Cyanethane.}$$

This is a mixture of two liquid substances of like composition and different properties.

Cyanides or Nitriles.

$ECy = C_6H_3,H_2N$; B.P. 88·5°.

Propionamide $C_6H_5O_2,H_2N - 2HO$ = *all* $(C_6H_3),H_2N$.

$C_6H_3,H_2N + 2HO$ = = propionamide.

$C_6H_3,H_2N + 4HO$ = = propionic acid and H_3N.

Nitriles are considered to be $C_{IV}\{^{(C_2H_5)}_{N_{III}}$

Non-poisonous.

Cyanides or Iso-Cyanides.

$ECy = C_2EN$; B.P. 78°.

$EH_2N + C_2H_1,Cl_3 + 3KO.HO$ = *all* C_2EN.

$C_2EN + 2HO$ = $= (C_2H_1O_2)HEN$.

$C_2EN + 4HO$ = = formic acid and EH_2N.

Carbamines are considered $N_{III}\{^{(C_2H_5)}_{C_{II}}$

Poisonous, purgent, nauseous, greater chemical activity, combine with HCl, &c., and oxy-acids, and yield cyanurates — carbimides.

It is amusing to see the cuprammonium notations, (NH_3cu), where cu means an equivalent = (31·75) instead of an atom Cu = 63, nor do I accept the apologetic explanation. "The notation cu is used, for an equivalent of copper, to simplify the formula." Away with *our* notions of simplicity that imply untruth! If equivalents are only imaginary conveniences, and diatomic atoms are the real thing, then by all means let us have them, however ugly or apparently confusing.

The chloro-cyanic acid, Cy_3Cl_2H, and chloro-cyanamide, $Cy_3(NH_2)_2Cl$, are comparatively unimportant substitutional varieties,—

The former possibly of D type, $C_6Cl_3N_3$,
Chloro-cyanic acid = $C_6Cl_2HN_3$
Of which C gives $C_6H_3N_3$

The ammeline of the books and that of Hofmann is undoubtedly an amide containing O; but the ammeline of S. Lupton may mean something else, and all depends on what is really intended, or should be intended by his outside (OH), an important point greatly confused by modern types. If it means that this (OH) is that of the hydrate or amine, then it might appear as a new and legitimate type of a new body, and the word "ammeline" would be a wrong designation.

It would have the elements of $Cy_3H_3N_2$.

The chloride, $Cy_3H_4N_2Cl$ = chloro-cyanamide.

The hydrate, $Cy_3H_4N_2O.HO$ = ammeline ?

But the notation $Cy_3(NH_2)_2$ would be inadmissible, as containing one H too many.

The inference that because a silver dicyanuramide has been obtained in a hydrated form therefore all others should be doubled is curiously invalid. Hofmann obtained a similar condensation, but omitted any such extravagant inference; we have purposely referred to one, a dimelanuric acid. Besides, it is notorious that such are common in organic chemistry.

Tetra-cyanides, $(Cy_4)_{IV}$.—This group, like No. 3, dwindles to almost nothing upon investigation. The cyanide of gold is undoubtedly a normal cyan-aurate, $KCy.AuCy_3$. The others are doubled proto-cyanides.

$Cy_4Ag_2K_2$ is given as Cy_2AgK in the dicyanides, and is plainly—

$KCy.AuCy$
$CyZnK_2$ is similarly $KCy.ZnCy$
Cy_4CuK_2 ,, $KCy.CuCy$
Cy_4PtK_2 ,, $KCy.PtCy$, &c.

Azulmic acid may be isomeric or identical with mykomelic acid; but why two acid terms for one indifferent amide? What that amide is, and what the character of its genesis, I hope to have shown (Chem. News, vol. xxxii., p. 209).

Mycomelic acid = (1.) $(C_4H_1O_4)Cy_2H_3N_2$ = azulmic acid.

(1.) $+ H_3N - 2HO$ - (2.) $(C_4H_1O_2)Cy_2H_3(NH_2)N_2$ = = hydrazulmoxin.

(2.) $+ H_3N - 2HO$ - (3.) $(C_4H_1)Cy_2H(NH_2)_2N_2$ = = hydrazulmin.

These bodies are exceedingly confused, and very unimportant for the main purposes of classification, and further knowledge will add to their isomeric and other variations.

Azulmin, or hydrazulmin, as directly produced by cyanogen and ammonia, might well suggest a different notation to that we have given, and from this point of view the following would be a more feasible interpretation :—

$$\left.\begin{matrix} 4Cy \\ 2H_2N \end{matrix}\right\} - \left.\begin{matrix} C_4H_2N_2 \\ C_2H_4N_2 \end{matrix}\right\} - C_4Cy_2H_6N_4 = \text{hydrazulmin,}$$

but the transition to azulmic acid herefrom is not easily seen. It is probably in a somewhat similar way that Gautier derives his azulmic acid, from the oxidation of 3HCy. It has the elements of $C_6H_3O_2N_3$, or double. Gautier notates it—

$$(N\{^{CO}_{H}.2CNH)_3,$$

or we may suppose $3HCy + O_2 = CO_2C_1H_3N_3$; then anticipating another connection, we have hydrazulmoxin by simple oxidation, giving azoulmoxin or azo-azulmoxin, which has the elements of $(CO)_4Cy_2H_3N_3$.

Penta-cyanides, $(Cy_5)^{v}$.

Hexa-cyanides, $(Cy_6)_{VI}$.—Here we have some cyano-salts of a well known type.

Cy_6PtBa is evidently $BaCy.PtCy_2$.
Cy_6RuK_2 ,, $KCy.RuCy_2$.
Cy_6OsK_2 ,, $KCy.OsCy_2$.
Cy_6TrK_2 ,, $KCy.TrCy_2$.
Cy_6RhK_2 ,, $KCy.RhCy_2$.

These are well confirmed with oxy, chloro, or sulpho types. The ferric cyanide $Cy_6Fe_2.3H_2O$ is evidently $Fe_2Cy_3.3HO$, and is more normal with $3HCy$.

The lead cyanurate is plainly $CO_6Pb_3N_3$
The silver ,, ,, $CO_6Ag_3N_3$, or its di.

Ammeline is given as $Cy_6(NH_2)_3(OH)_3$, but wherefore? and why these hydroxyls and amides?

2 ammeline, $(CO_6C_3H_3N_3 + 2HO$ - ammelide $(CO_6C_3H_3N_3$ and $1H_2N$.

Or we may say cyanuric acid + melamine = ammelide. Also, ammelide $- 2H_3N$ = cyameluric acid, $(CO_6)Cy_3H_3N_4$.

2 melamine $- H_3N$ = melain $Cy_6H_9N_5$.

Hepta-cyanides, " wanting."

Octa-cyanides, $(Cy_8)_{VIII}$.—Here are only three puzzles. "The magnetic cyanide of M. Fehling" is evidently

... Cy_6, and corresponds to the magnetic oxide of iron, Fe_3O_4; and in Prussian's new sulphosalts it becomes an octahedral type, $2KCy.Fe_2Cy_3$, with many varieties.

The potassio cuprous cyanide may be $3KCy.CuCy$, but cuprous protodes mostly have 2 atoms of base, and in many cases only one.

Azoulmoxin we have referred to.

Lower cyanides, $(Cy_{10})^x$.—Here are only two puzzles, $Cy_9N.NH_2$; mellon! But why $3(NH)$, or why N by itself?

3 melamine $-5H_3N$ = the elements of mellon, $Cy_9H_3N_4$. Gautier's azulmic acid we have referred to.

Deka-cyanides, $(Cy_{10})^x$.—The potassium platina cyanide, $Cy_{10}Pt_2K_4$, is evidently $2KCy.Pt_2Cy_3$, a type somewhat unusual with platinum (only one given), but very common with iron and other elements, which are mostly tribasic. The corresponding sulpho-salt may have one or two atoms of base.

Hendeka-cyanides, $(Cy_{11})^{xi}$.—"Wanting."

Dodeka-cyanides, $(Cy_{12})^{xii}$.—These comprehend two separate and well-known groups, the ferro- and ferricyanides. As the former contain 3 equivalents of Cy and the latter 6, two multiplicands of 4 and 2, with a characteristic disregard of chemical evidence, make one group with one type of twelve-fold atomicity!

The Ferro-cyanides.

$Cy_{12}Fe_2H_8$	is undoubtedly	$2HCy.FeCy$
$Cy_{12}Fe_2K_8$	,,	$2KCy.FeCy$
$Cy_{12}Fe_4Ca_4.H_2O$	,,	$2CaCy.FeCy$
		$2KCy.NiCy.$

These are normal types which may be extended indefinitely; there are only three abnormal or inverted types—

$Cy_{12}Fe_2Fe_2K_4$	$KCy.2FeCy$
$Cy_{12}Fe_2Sr_2K_4.3H_2O$	$KCy.FeCy$
	$SrCy$
$Cy_{12}Fe_2Fe_2(NH_3fe)_4$	$ACy.2FeCy$
	$A-H_3FeNCy.$

These cyanides crystallise with various amounts of HO, and analysed at any given desiccation the inferences of di or tetra compounds may be extremely unsatisfactory.

The Ferri-cyanides.

$Cy_{12}Fe_2H_6$	is undoubtedly	$3HCy.Fe_2Cy_3$
$Cy_{12}Fe_2K_6$	,,	$3KCy.Fe_2Cy_3$
$Cy_{12}Fe_2Ca_3$	,,	$3CaCy.Fe_2Cy_3$
$Cy_{12}Co_2K_6$	,,	$3KCy.Co_2Cy_3$
$Cy_{12}Mn_2K_6$	,,	$3KCy.Mn_2Cy_3$
$Cy_{12}Cr_2K_6$	,,	$3KCy.Cr_2Cy_3.$

These familiar salts are well known in corresponding oxy, chloro, sulpho, and other forms, with no attempt to make either O or Cl to possess a dodeka atomicity!

If the ferro- and ferri-cyanides, the prussiates of potash of commerce containing no potash, were the only forms of cyan-ferric acid we might eclectically tolerate the common designations, but as there are other types, and the group is greatly enlarged by oxy, chloro, sulpho, and other analogues, it is important to understand the conditions involved in a rational and simple nomenclature; and if we always bear in mind that the prefix oxy is understood without expression in oxy-salts, the wide extension of this old principle is an easy matter, according to which we have—

Sulphates	$KO.SO_3$
Aurates	$KO.AuO_3$
Chlo-aurates	$KCl.AuCl_3$
Cyano-aurates	$KCy.AuCy_3$, &c.

We might well and safely trust a Lindley or a Hooker to a greenhouse study of Hybrid Botany; but modern chemists luxuriate in such regions without any logical regard or discriminative appreciation of the normal and abnormal: we therefore conclude with two or three complexities which might have adorned the above list of cyanogen atomicities.

M. Claus has discovered some melamine derivatives :—

Melamine + 2HS −	$H_2N = (CS)_2Cy_2H_2N_3$,	sulph-ammeline
2 ,, ,,	$2H_2N = (CS)_2Cy_3H_5N_5$	,,
3 ,, ,,	$3H_2N = (CS)_2C_3H_{11}N_7$	,,

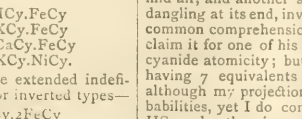
And from another physicist we have a parallel study of so-called "prussiamic acids," the first term being identical with the second of M. Claus; and does it thence follow that sulph-ammeline is a "mono-thio-prussiamic acid"?

2 melamine + 2HS − $2H_3N$ = mono-thio-diprussiamic acid, $(CS)_2Cy_5H_8N_5$.

2 melamine = 4HS − $3H_3N$ = di-thio-diprussiamic acid,— $(CS)_4Cy_4H_7N_5$.

3 melamine + 4HS − $3H_3N$ = di-thio-triprussiamic acid,— $(CS)_4Cy_7H_{13}N_5$.

The names and notations are a prodigious mistake, and out of respect to the printer we only give the constitutional picture of the latter amide :—



Why one of these hooks should be suspended *minus* in mid air, and another should have two radicals or groups dangling at its end, involves an order of symmetry beyond common comprehension. Mr. Sidney Lupton may well claim it for one of his very slender groups with an enneacyanide atomicity; but, on the contrary, we claim it as having 7 equivalents of cyanogen instead of 9; and although my projections are only mooted as *à priori* probabilities, yet I do contend that the function +2HO or HS, under the circumstances, is patent to a popular and amateur understanding, although it may be utterly ignored by our great masters in this school of thought and endeavour.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

December 1, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

PROF. GRAHAM BELL exhibited and described the Telephone before a crowded meeting of the Society, prefacing his account of the apparatus now so well known by a very complete historical sketch of the progress of electric telephony. The first experiments referred to were those of Prof. Page, who in 1837 was studying the relation of electricity to magnetism, and found that if a coil of wire, traversed by a current, surrounds an irod rod, a sound like a pistol shot proceeds from this latter whenever the current is made or broken. He was followed by De la Rive, Poggendorff, Reiss, and others; but Reiss was the first to employ the human voice in his experiments. After pointing out that in transmitting sounds by electrical means the initial sounds themselves are in no sense transmitted, but are only employed to generate currents which reproduce similar sounds, Prof. Bell proceeded to examine the phenomena which take place when sounds are transmitted through the air. It is, of course, not the motion of the vocal organs themselves that is received in the ear, but that of the air set in motion by their means, and all peculiarities in the sound must be peculiarities in the motion of that air. If the rapidity of motion varies it occasions a variation in the pitch, and the loudness is changed by changing the amplitude. The *shape* of the vibration produces timbre. If, by moving the air in certain specified ways, certain vowel sounds are given out, then those same

sounds will be emitted if an identical movement be occasioned by any mechanical means whatever; and Prof. Bell has found that such a motion may really be given to the air in various ways. Three classes of electrical currents have been employed for transmitting sounds to a distance, and these he denominates Intermittent, Pulsatory, and Undulatory. The first form is obtained when a current passes for a brief interval, is then followed by an interval during which no current passes, and this by a current of the same or opposite sign. In the second class a current is continually passing, but its intensity increases and decreases instantaneously; and finally, in the third class, this variation takes place gradually, and may therefore be represented by a sinuous line. In his experiments on the nature of the movement of the air Prof. Bell employed a human ear, a straw style attached to the incus recording the movement communicated to it on a moving sheet of smoked glass. A very interesting series of curves produced by this means was shown upon the screen, and he explained how his experiments in this direction led him to the present form of telephone. Since the very small membrane of the ear was capable of setting in motion comparatively large bones, it seemed probable that it could cause a light piece of iron to vibrate. In the earlier form of apparatus a piece of steel spring was therefore attached to a stretched membrane of gold-beater's skin, and placed in front of the pole of the magnet; but he found on increasing the area of metal that the action of the instrument was improved, and thus was led to do away with the membrane itself. Another branch of the investigation referred to the strength of the magnet employed, and this was modified by varying the strength of current. The battery was gradually reduced from fifty cells to none at all, and still the effects were observed, but in a much less marked degree: the action was in this latter case doubtless due to residual magnetism,—hence, in the present form of apparatus, a permanent magnet is employed. Lastly, the effect of varying the dimensions of the coil of wire was studied, when it was found that the sounds became louder as its length was diminished: a certain length was, however, ultimately reached, beyond which no improvement was effected, and it was found to be only necessary to enclose one end of the magnet in the coil of wire. A number of diagrams were projected on to the screen, which showed the various forms the apparatus has taken from the time of Page to the present day. An air sung in a distant part of the building was distinctly heard in the room by the aid of an improved form of Reiss's telephone, lent by Prof. Barrett, and made by Mr. Yates, of Dublin. Prof. Bell, Prof. Foster, and Dr. Gladstone then carried on a conversation with a gentleman at a distance, and utterances were shown to be audible when the transmitting instrument was held about a foot from the mouth.

A discussion then followed, in which Mr. De la Rue, Dr. Gladstone, Profs. Foster, Guthrie, Atkinson, and others took part.

In replying to the various questions Prof. Bell stated that his attempts to determine the amplitude of the vibrations had not been successful, and he is coming to the conclusion that the movement must be molecular. Very distinct sounds are emitted when a considerable mass of iron is employed; and further, if the iron be glued to a piece of wood an inch thick, and this be interposed between it and the magnet, the action still continues. Conversation has been carried on through a distance of 258 miles, but a resistance of 60,000 ohms has been interposed without preventing the action. There is a very marked difference in the manner in which letters are reproduced by the telephone. Vowel sounds are more acceptable than consonants, and, as a rule, those letters are best transmitted which involve a large oral aperture in their utterance. Finally, he finds that high sounds are produced more fully than low ones; but this question has not yet received sufficient attention.

UNIVERSITY COLLEGE CHEMICAL AND PHYSICAL SOCIETY.

Prof. G. Carey Foster, F.R.S., in the Chair.

At a meeting of this Society held on November 29th a paper was read on "*The Telephone*," by Mr. H. Forster Morley, M.A., B.Sc. (Vice-President). An exceedingly large audience had assembled to hear the reading of this paper, Profs. Remedy, Croom-Robertson, Ringer, Maudsley, and Mr. Serjeant Simon, M.P., being among the number.

Mr. Morley commenced his paper by pointing out the circumstances which led to Prof. Bell turning his attention to the subject of Telephony; and after reminding his hearers of a few points connected with the theories of Sound and Electricity necessary for the elucidation of the subject in hand, he proceeded to consider the first forms of telephones, devoting especial attention to the description and explanation of the experiments of Helmholtz. He then proceeded to sketch the steps by which Prof. Bell had been led up to the present form of telephone, the first instrument capable of transmitting artículate sounds in a satisfactory manner. Mr. Morley went on to give an elaborate and detailed description of the apparatus in its present form, showing its construction, explaining the theory of its action, and calling special attention to the fact that the satisfactory working of Prof. Bell's instrument was due to approximately undulatory currents being produced in the wire, whereas in previous instruments only intermittent or pulsatory currents had been obtained.

Several very successful experiments were then made; the sound of the telephonic organ, amongst other things, being very distinctly heard in every part of the room by means of the ordinary small telephones.

The Chairman, in moving that the thanks of the meeting be accorded to Mr. Morley for his lecture, remarked on the able and careful way in which his paper was written, and then proceeded to congratulate the Society on its present prosperous condition, and to wish it success in the future.

The thanks of the meeting having been heartily given to Mr. Morley, a vote of thanks to Prof. Graham Bell for his kindness in lending the Society his instruments was moved by Mr. Chas. Cassal (the Secretary), seconded by Mr. Plimpton (Treasurer), and carried by acclamation, as was also a vote of thanks to Prof. Foster, which was moved by Dr. O. J. Lodge (President), and seconded by Mr. Wright.

The Chairman having briefly returned thanks, the proceedings terminated.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

November 12, 1877.

Prof. A. W. Hofmann, F.R.S., Vice-President, in the Chair.

Dr. C. A. Martius presented a call, signed by thirty leading firms, summoning all interested in forming a Society of German chemical manufacturers to an organisation meeting at Frankfort, on November 25th.

Prof. Buff (of Giessen), Prof. G. Kirchhoff (of Berlin), and Prof. G. Stenhouse (of London) were proposed as honorary members of the Society. The chemical library of the late Prof. Oppenheim has been bequeathed to the Society. The following communications were presented:—

C. Böttinger, "*Acetylen Urea.*" The author obtains, by the action of CNH on glyoxal and urea, a body, $C_4H_6N_4O_2$, corresponding to the acetylen-carbamide lately described by Schiff in the *Annalen*.

M. JAFFE, "*Action of Benzoic Acid in the Organisms of Birds.*" The author finds, in the excrement of birds which have been fed on benzoic acid, a new acid—ornithuric acid—crystallising in colourless needles, yielding amorphous salts only, and possessing the formula $C_{19}H_{20}N_2O_4$. By treatment with HCl the acid is decomposed into benzoic acid (2 mols.), and a new base, $C_{15}H_{12}N_2O_2$, which forms a double row of crystalline salts with acids. The base is considered as the first diamido-derivative in the fatty series, and ornithuric acid results from its union with benzoic acid in the organism of birds as follows:—

$$2(C_6H_5COOH)+C_5H_{12}N_2O_2=C_{19}H_{20}N_2O_4+2H_2O.$$

H. MEYER and M. JAFFE confirm the experiments of Cech on "*The Formation of Uric Acid in the Organisms of Birds*" (CHEM. NEWS, xxxvi., 39), showing that urea, when fed to fowls, is completely changed into uric acid.

R. NIETZKI, "*Preparation of Quinons and Hydroquinons.*" At present quinon costs about the same as metallic gold. The author has formed a method by which it can easily be prepared, at about twelve times the cost of aniline, by simply oxidising the latter. The process consists in dissolving aniline in dilute H_2SO_4, adding slowly a cold solution of bichromate of potash, passing a stream of SO_2 through the product of the reaction, and extraction with ether. According to the amount of bichromate used, hydroquinon or quinon is formed—18 per cent of the former and 9 per cent of the latter. With equal ease hydro-tolu-quinon is obtained from ortho-toluidin. For the crystallisation of the two hydroquinons crude toluen can be used to good advantage.

S. HOOGEWERFF and W. A. VAN DORP, "*Oxidation of Compounds containing* N *by means of* $KMnO_4$." It is ascertained, in harmony with the experiments of Wanklyn and Chapman, that in several compounds one-half of the N present is changed into NH_3. Aniline yields 50 per cent of its N as NH_3, 33 per cent as ozo-benzene, with small quantities of nitrates and nitrites, requiring nine times its weight of $KMnO_4$ for complete oxidation. The author's experiments show likewise that NH_3 is not oxidised by $KMnO_4$.

W. MEYERINGH, "*Volumetric Determination of Hydroxylamin, and new Double Salts of this Compound.*" Several methods are described. With iodine solution exactly 2 atoms of I are required for the oxidation of 1 mol. hydroxylamin, if the HI thereby formed is at once neutralised with MgO:—

$$2NH_3O+2I_2=N_2O+H_2O+4HI.$$

Trituration with a permanganate solution, after oxidation with $Fe_2(SO_4)_3$ at 90°, gives equally reliable results; 1 mol. hydroxylamin requiring 1 atom O:—

$$2Fe_2(SO_4)_3+2NH_3O-4FeSO_4+2H_2SO_4+N_2O+H_2O.$$

Fehling's solution can also be used, 1 mol. hydroxylamin being oxidised regularly by 2 mols. CuO in alkaline solution. Chromic acid is not practicable. Among new salts described are

$$MgSO_4(NH_2OH)_2H_2SO_4.6\text{ aq.},$$
$$(NH_2OH)_2H_2SO_4.Al_2(SO_4)_3.24\text{ aq.},$$

and the corresponding Cr and Fe salts, all of which crystallise in handsome octahedra.

H. BECKURTS and R. OTTO prepare "*Monochlor-acrylic Acid*" by adding Ag_2CO_3 to α-dichloro-propionic acid, and distilling the product. The acid $CH_2.CCl.COOH$ thus obtained is an oily liquid, soluble in all the ordinary solvents, volatile at low temperatures, and boiling at 176°. A number of salts are described. By heating with HCl the acid is changed into α-dichloro-propionic acid; and by treatment with nascent H, propionic acid results.

H. SCHNAPP prepares "*Diethyl-β-oxybutyric Acid*" by treating diethyl-aceto-acetic ether with sodium-amalgam—

$$CH_3.CO.C(C_2H_5)_2.CO.OC_2H_5+2H_2O+Na_2=$$
$$CH_3.CHOH.C(C_2H_5)_2.CO.ONa+NaOH+C_2H_6O.$$

The acid is a syrupy liquid, soluble with difficulty in H_2O, and yielding, on heating, ethylic aldehyd and diethyl-acetic acid, $CH_3.CHO+CH(C_2H_5)_2.COOH$. The latter boils at 195°, is lighter than water, and gives an ethylic ether boiling at 151°.

A. RÜCKER obtains "*Methyl-crotonic Acid*," $C_5H_8O_2$, by the action of HI on methyl-aceto-acetic ether, and, by treatment of the same compound with PCl_5, chloro-methyl-crotonic acid, $C_5H_7ClO_2$, melting at 69°, and volatilising slightly higher.

E. J. HALLOCK describes a new "*Lecture Experiment*," for the illustration of the present method of preparing bicarbonate of soda, which consists essentially of a cylinder filled with a saturated solution of NaCl, and separated into divisions by wire-gauze. CO_2 is introduced at the bottom of the cylinder, and NH_3 at the top. The resultant ammonium bicarbonate is decomposed by the NaCl solution into ammonium chloride and sodium bicarbonate, which is deposited on the wire nets.

C. WOLFF, "*Diallyl-aceto-acetic Ether and its Derivatives.*" This ether, $CH_3.CO.C(C_3H_5)_2.COOC_2H_5$, is obtained, by the action of allylic iodide on sodium-allyl-aceto-acetic ether, as a colourless oil, boiling at 240°. By heating with potash it is decomposed into diallyl-aceton, $CH_3.CO.CH(C_3H_5)_2$, a colourless, oily liquid, boiling at 175°; and diallyl-acetic acid, $CH(C_3H_5)_2.COOH$, which boils at 222°.

M. REIMANN, "*Action of Precibitated Sulphur in Dyeing.*" Since the introduction of aniline-green as a dye for woollen fabrics the only mordant used has been a warm solution of sodium hyposulphite which has been treated with HCl. The author, regarding its action as analogous to that of precipitated silicic acid in aniline dyeing, considers the "sulphur milk" thus formed to be the true mordant. The following experiments show the correctness of the theory:—The cloudiness resulting from the addition of HCl to a solution of hypo-sulphite, and consisting of finely-divided sulphur, is entirely removed by introducing woollen threads into the solution. Samples of threads which have been soaked in CS_2 take exactly the same shade, on immersion in the aniline bath, as those treated with "sulphur milk." The latter threads also, after being boiled with HNaO and treated with HCl, emitted a trace of H_2S, and lost their power of fixing colours. The author is investigating the action of sulphur as used for eosin and its derivative dye-stuffs, and the practicability of its more general application in dyeing.

C. A. BELL and E. LAPPER obtain, by the "*Dry Distillation of Ammonium Saccharate*," pyrrol,—

$$C_6H_{16}O_8(NH_3)_2=C_4H_5N+2CO_2+4H_2O+NH_3,$$

and, by the distillation of ethyl-amine saccharate, ethyl-pyrrol. The isomeric mucic acid yields in both cases csrbo-pyrrol amides. Theoretical considerations on the formulæ of the acids follow.

A. PINNER, "*Chloral Derivatives.*" In opposition to Schiff's views, the author considers that in the compounds of the chlorals with acetamide, &c., the acetyl group is not united to N from analogy with the compound—

$$CCl_3.CH\begin{cases}NH_2\\OC_2H_3O.\end{cases}$$

P. J. MEYER, "*Substituted Sulpho-hydantoïns.*" Sulpho-carbamide and chlor-acet-anilide yield, on heating, sulpho-hydantoïn and phenyl-sulpho-hydantoïn,—

$$\begin{matrix}CH_2.NH\\CO.N(C_6H_5)\end{matrix}>CS,$$

yellow crystals, insoluble in H_2O, melting at 178°. Chlor-aceto-toluidide forms a similar compound, toluyl-sulpho-hydantoïn.

"*Action of Heat on Glycocolls.*" Phenyl-glycocoll, when heated at 140° to 150°, loses H_2O, and yields the two bodies—

$$\begin{matrix}CH_2\\CO\end{matrix}>N(C_6H_5)$$

and—

$$[CH_2.NH(C_6H_5).CO]_2O.$$

O. Doebner, "*Synthesis of Oxyketones by the Introduction of Acid Radicals into Phenols.*" The author has ascertained that acid radicals are easily substituted for H in phenols, if an acid radical is previously introduced into the hydroxyl group of the phenol. Thus phenol, on treatment with benzoyl chloride, yields phenyl-benzoate, $C_6H_5OOC.C_6H_5$, which, on further treatment with zinc chloride and benzoyl chloride, is changed into benzoyl-phenol-benzoate, $C_6H_5CO.C_6H_4O.OC_7C_6H_5$, *i.e.*, the ether of benzoyl-phenol.

O. Doebner and W. Stackmann, "*Benzoyl-phenol.*" The authors prepare this from the above-mentioned benzoyl-phenol-benzoate, by saponification with alcoholic potash, solution in H_2O, and precipitation with CO_2. The acetate $C_6H_5COC_6H_4O(COCH_3)$, obtained by heating with acetic anhydride, crystallises in colourless needles, and is easily decomposed by alkalies. Reduction with sodium-amalgam yields benzhydryl-phenol,—

$$C_6H_5CH(OH)(C_6H_4OH),$$

possessing the properties of a secondary alcohol and a phenol. By fusion with HKO benzoyl-phenol yields paroxy-benzoic acid, which would seem to show that it belongs to the para series.

CORRESPONDENCE.

CONTRIBUTIONS TO CHEMICAL ANALYSIS.

To the Editor of the Chemical News.

Sir,—Will you kindly insert in your journal the following letter?—

During the last few months I could not find enough time to analyse Mr. A. H. Allen's letter (Chem. News, vol. xxxvi., p. 33), in which thunder and lightning was sent against my small notes published from time to time in your valuable periodical.

I will try to answer as briefly as possible.

1. The erroneous percentage of P in $Mg_2P_2O_7$, given by me in my paper (Chem. News, vol. xxxv., p. 1) was a mistake made by me indeed while writing the article. This fact I acknowledge.

2. In my paper on analyses of slags, clays, &c. (Chem. News, vol. xxxv., p. 203) it is mentioned that $Mg_2P_2O_7$ contains 36·04 per cent of *magnesium*: this should have been *magnesia*. The error is evident, as this metal, in analyses of clays, slags, iron ores, &c., is always calculated as magnesia.

3. The wonderful error in the calculation of the percentage of chromium in chrome-iron ores (Chem. News, vol. xxxv., p. 107) showed me—unfortunately after the appearance of the paper in the press—that calculations should always be made by chemists themselves, and not by other persons, as it happened in the present case.

4. Some words on the metal davyum. Bunsen, indeed, pointed out the probability of the existence of some new metals in the platinum group. The author certainly knew this fact, and it lessened the task of the discoverer. It is well to mention here that M. Lecoq de Boisbaudran discovered, as it is known, the metal gallium, which was found to be M. Mendeleeff's hypothetical element, eka-aluminium, the properties of which quite agree with those of gallium given by M. Mendeleeff (*Comptes Rendus*, No. 21, Nov. 22, 1875). In this case M. Mendeleeff may easily claim the discovery of gallium under another name only. I think if one person supposed that a metal existed and another found it out, the last may certainly claim the discovery. Mr. Allen tells us that the reactions of davyum show nothing exceptional. I suppose, and many I think suppose, that a preliminary notice cannot give details. In my further communications (Chem. News, vol. xxxvi., pp. 114, 155) some particular reactions are described; further work will show something new again. In chemistry, as in every science, a new discovery cannot be worked out at once. Mr. Allen remarks, also, that the reaction of Da with KCyS is not shared only by iron (and remarks that I suppose so), but that it is common also to uranium and ruthenium, and *probably* to other metals (?). First, I cannot understand why Mr. Allen thinks that I suppose the iron only to have a reaction with KCNS, similar to the reaction of Da with KCys. That is an open question. I simply notice in my paper (Chem. News, vol. xxxvi., p. 4) that the "davyum chloride gives, with potassium, sulpho-cyanide—a red colouration, identical with the colouration produced by mixing solutions of KCyS and $FeSO_4$ (ferric salts)." Why should I not say so? If the colouration were a blue one I should mention that it is identical with the colouration of a solution of $CuSO_4$. Every chemist knows the reactions of Fe, Ur, and Ru, and if Mr. Allen wished to tell that the reaction between Da and KCyS is not characteristic I may add the following:—With potassium sulpho-cyanide—

Ru gives a rose colouration, which on heating the liquor turns purple. (Bunsen ascribes this reaction to the presence of other unknown metals of the platinum group.)

Fe, red colouration; no precipitate.

Ur, dark yellow colouration; the liquor on being heated gives a yellowish white precipitate; the precipitation is not full

Da, red colouration in feeble solutions of the metal; red precipitate in concentrated solutions.

5. In conclusion, I append a note on the inference of Mr. Allen:—The H_2S and SO_2 are frequent not only in Russian coal-gas, which in St. Petersburg is made entirely from English coals; and I find nothing strange in passing it through a compound absorbing the above-mentioned gases, noxious in regard to platinum.—I am, &c.,

Serg us Kern.

4°, Rue aux Pois, St. Petersburg,
October 30, 1877.

ACTION OF SULPHURIC ACID AND OXIDISING AGENTS ON MORPHIA AND ITS SALTS.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xxxvi., page 228) Mr. David Lindo contributes a paper on the above subject. The reaction there described may be one of considerable delicacy, but it is by no means characteristic of morphia. I have found that both codeia and narcotin, when warmed with hydric sulphate, diluted with water, and mixed with nitric acid in the manner recommended by Mr. Lindo, give colour-reactions practically undistinguishable from that produced by morphia and its salts when similarly treated. Potassic dichromate may be substituted for nitric acid, whence it is probable that other oxidising agents would act in the same way. The test in question, with thebaine, papaverine, and narceine, gives only negative results.—I am, &c.,

David B. Dott.

93, Abbey Hill, Edinburgh, Nov. 30, 1877.

MARBELLA IRONSTONE.

To the Editor of the Chemical News.

Sir,—I think that if any user of Marbella ore accepts the analysis given by Dr. Wallace in your issue of last week he will find himself mistaken. I do not in the least doubt that Dr. Wallace made his analysis quite correctly, but I feel sure he must have had a particularly good sample sent to him, or the ore must have been better when he analysed it than it is now. I have had to work with large quantities of Marbella, and have had a good many analyses made, and instead of traces only of bisulphide of

on I have invariably found a considerable quantity, usually an amount equivalent to two-tenths per cent of sulphur, sometimes less, sometimes more. Lime averages 1 per cent, and magnesia between 6 and 7 per cent. The iron varies between 56 and 59, and may be taken as averaging 57½. The samples I had taken were from cargoes, and were fairly taken, in the case of large cargoes amounting even to tons; these samples were broken, halved, broken smaller, again halved, again broken, and so on.

I would not have wished to take up your space, but that I feared some persons might be led to consider the ore as remarkably pure, which the bulk is not, though it would be easy to pick out some very good pieces.—I am, &c.,

G. S. Packer.

Hallside by Glasgow, Dec. 3, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 21, November 19, 1877.

New Remarks on the Quantities of Heat Liberated by the Mixture of Water with Sulphuric Acid.—M. Berthelot.—The properties of sulphuric acid are always the same, and it evolves identical quantities of heat whether it has been recently heated or preserved for a considerable time. The author has ascertained this fact with precision on two occasions, having been led to examine it in the course of other researches. The following are the numbers obtained on causing 1 part of boiled acid (containing about 98 per cent of real acid) to act upon 70 parts of water:—

	Calories.
Acid kept several years, at 22°	168·2
Acid kept for a month, at 20°	167·0
Acid lately heated to ebullition, at 17°	166·6

The differences between these numbers are very trifling, and are further reduced if all the figures are calculated for the same temperature, say 22°:—168·2; 167·7; 168·3.

Use of Neutral Refined Oils for Lubricating Pistons in Engines Fitted with Surface Condensers.—M. O. Allaire.—The author investigates the nature of the deposits formed in the condensers and in the boilers of marine engines. If the oils hitherto used for lubricating cylinders yield about 50 per cent of their weight of a residue containing more than one-half of oxide of iron, an oil where the free acids have been removed yields only 19 per cent of a residue containing merely 6 per cent oxide of iron. All oils, without exception, even such as have not undergone any treatment with acids, contain a very large proportion of free acids, to which the formation of the deposits is ascribed.

Reproduction of Orthose.—M. P. Hautefeuille.—Orthose may be artificially prepared by heating to between 900° and 1000° a mixture of tungstic acid and of a very alkaline silico-aluminate of potassa, containing 1 equiv. of alumina to 6 equivs. of silica.

Composition and the Industrial Use of the Gases from Metallurgical Furnaces.—M. L. Cailletet.—On collecting the gases which circulate in the hottest part of iron furnaces the author, by the aid of an apparatus analogous to that of M. Deville, has been able to show that the composition of these gases, when cooled suddenly, differs completely from the results given by the analyses of Ebelmen. This skilful metallurgist, ignoring the phenomena of dissociation, collected the gases by aspiring them slowly through a long tube, which necessarily involved the combination of their dissociated elements. In the analyses of Ebelmen the reaction seems almost always complete, whilst the sudden cooling of the gases shows that smoke and carburetted gases may exist in the presence of oxygen at the temperature of melting iron. The author considers it proved by his experiments that the gases evolved from metallurgical furnaces still contain, even after their passage under steam boilers, an important quantity of combustible matter, which it is easy to ignite and to burn almost entirely. The passage or reducing gases along metallic surfaces at a red heat may receive important metallurgical operations in addition to the annealing of sheet-iron.

Formation of Iodous Acid by the Action of Ozone upon Iodine.—M. J. Ogier.—We may operate, either by causing ozonised oxygen to act upon the vapour of iodine, or by submitting a mixture of oxygen and iodine to the electric effluve. In each case the products are the same: the ultimate stage of an oxidation sufficiently prolonged is always a white or yellowish matter, unalterable in the air, soluble in water without apparent decomposition, and in which the oxygen and iodine were found united in the proportions suitable for iodic acid. In certain cases the author obtained a product sparingly soluble in water, the properties of which agreed with Millon's hypoiodic acid. The following arrangement was adopted for the formation of iodous acid:—A rapid current of ozone was led by a tube to the bottom of a flask containing iodine kept at 44° to 50°. The ozone being immediately destroyed on contact with the vapour of iodine, the solid particles formed were carried with the excess of oxygen along a lateral tube. A series of narrow glass tubes containing platinum spirals serves to break the gaseous current, and to arrest these particles whose tenuity is extreme. The product is a pale yellow powder, exceedingly light. If treated with water iodine is precipitated. If exposed to moist air it seems to disappear in a few seconds.

Solubility of Sugar in Water.—M. H. Courtonne.—100 grms. of water at 12·5° dissolve 198·647 grms. of sugar, and at 45° 245 grms. In other words, a solution of sugar saturated at 12·5° contains 66·5 per cent, and a solution saturated at 45° contains 71 per cent.

Oxidation-Products of Camphor.—M. J. de Montgolfier.—An examination of the production of the camphic, camphoric, and oxycamphic acids.

Bismuth-Minerals of Bolivia, Peru, and Chili.—M Domeyko.—The sulphuretted minerals are Bolivite, which appears to be an oxysulphide composed of protosulphide, Bi_2S_2, and of sesquioxide, Bi_2O_3. Bismuthine is found in considerable quantities in the mines of Chorolque, in Bolivia. A double sulphide of bismuth and copper occurs in the mines of Cerro Blanco, in the Chilian province of Atacama. A sulphide of bismuth rich in silver is found in the mine Santa Matilda, at Morocochu, in Peru. The principal oxidised minerals are taznite, a chloro-arseniate and chloro-antimoniate of bismuth, found at Tazna, in Bolivia. The oxychloride (Daubreite) comes from the superficial part of the same deposit. A compact, earthy, hydrated oxide is the most common Bolivian ore of bismuth. A hydrated silicate accompanies the sulphide at Chorolque. Native bismuth is very common in Bolivia, accompanying the oxysulphide of Tazna, and containing no tellurium. In other localities native bismuth is found along with gold. There is also a telluride of bismuth and silver.

Bulletin de la Societe Chimique de Paris, No. 10, November 5, 1877.

Thermo-chemical Determinations.—M. Berthelot.—These determinations relate to the oxides of nitrogen; to oxy-ammonia, $N+H_3+O_2$; to the compounds of the halogens; the cyanogen series, &c.; the heat of combination referred to the solid state; the formation of solid salts

from hydrated acids and bases, both solids; the formation of various organic compounds from their elements, *i.e.*, gaseous hydrogen, oxygen, and nitrogen, and carbon as diamond; and the formation of ethers by means of alcohols.

Iodide of Starch.—M. Bondonneau.—Already noticed.

New Researches on the Ammoniacal Fermentation of Urine, and on Spontaneous Fermentation.—MM. Paul Cazeneuve and Charles Livon.—When the urine of animals is exposed to the air the urea becomes hydrated, and is resolved into carbonate of ammonia, whilst vibriones make their appearance in the liquid. These facts meet with various interpretations. Müller, Pasteur, and Van Tieghem ascribe the hydration of the urea to the action of a special Torulacea. Pasteur and Joubert consider that this action of the Torulacea is due more directly to the secretion of a soluble ferment, a sort of diastase. Fremy considers that a "hemi-organic" substance, present in all animal and vegetable liquids, is the immediate cause of the transformation of the urea. M. Béchamp finds in all animal humours molecular granulations, to which he ascribes life, and lets them play an active part in all fermentations under the name of microzymas. He supposes that in urine there are abnormal microzymas, which transform urea into carbonate of ammonia. Verneuil thinks that leucocytes may modify urea like the torulacea of Pasteur and Van Tieghem. M. Bouley ascribes the change possibly to pus, blood, or mucus, whilst Poggiale hesitates to attribute this part of hydration exclusively to the torulacea. As regards the origin of the vibriones there are two conflicting schools—the heterogenists (Dr. Bastian, Onimus, &c.), who believe in the creation of the little beings in the midst of the urine by the concourse of physico-chemical forces; and the physiological school, of which Pasteur is the most eminent representative, and which ascribes the birth of vibriones to vibriones, the air being a means of transport of these animalcules and their germs. The authors have experimented on the subject—not in glass vessels, like M. Pasteur—but in the bladders of living animals, or, as they rather curiously express it, *in anima vili!* The urine of dogs was rendered alkaline, either by the administration of bicarbonate of soda, acetate of potassa, &c., or by certain nervous lesions, but when withdrawn from the bladder by means of an operation it was invariably found free from ammoniacal fermentation, and contained neither torulaceæ nor vibriones. If, however, air was admitted into the bladder by a slit, ammoniacal fermentation speedily set in, and vibriones made their appearance.

Formation of Allylen at the expense of the Bromo-citraconic and Bromo-citra-pyrotartaric Anhydrides.—M. E. Bourgoin.—The author having dissolved bromo-citra-pyro-tartaric anhydride in water, saturated the solution with ammonia, and added silver nitrate in excess, heated the resulting salt for some hours to 130° in a closed vessel. On opening the tube a large quantity of gas escaped which proved to be allylen.

Action of Hydrochloric Acid upon two Isomeric Butylens and upon the Olefines in General.—M. J. A. Le Bel.

Justus Liebig's Annalen der Chemie,
Band 189, Heft 3.

Chemical Compounds in Liquid Storax.—Dr. W. von Miller (Second treatise).—We have here an account of styrol, styracin, cinnamic-phenyl-propylester, and storesin.

New Method of Determining Casein and Fats in Milk.—Julius Lehmann.—The author after pointing out the impossibility of deciding on the quality of milk otherwise than by a quantitative analysis, and after pronouncing all known methods too tedious and circumstantial, speaks of his experiments on the behaviour of milk upon baked plates of porous clay. From these experiments it appears that if milk is poured slowly upon such plates by means of a pipettte or small glass syringe in a continuous stratum of about 2 m.m. in thickness there remains, after the lapse of one or two hours, a consistent coating with a sharply defined outline, of a pale yellowish colour and a fatty lustre, which can be readily removed from the plate by means of a sharp horn spatula in the form of fine translucent laminæ. After exposure for some time to moderately dry air, or especially if dried over sulphuric acid, they become so brittle that they can be broken between the fingers. At a temperature of about 30° fat exudes out of the laminæ, and covers their entire surface. After extraction with ether there remains a white, translucent, easily friable mass. This, when thoroughly freed from fat, consists of casein, containing ash, and very small proportions of albumen and milk-sugar. Hence the two latter substances are capable of being separated from the serum by means of clay plates. It further appears that in this manner casein may be separated with the same properties as if it had been precipitated by rennet. If rubbed up with water it swells to a white flocculent matter, which remains behind on filtering the mixture through blotting-paper. On treatment with lime-water it returns to the state in which it originally existed in the milk. It then passes through filter-paper along with water, and can be precipitated with acetic acid. If the casein still retains the proportion of fat which was left with it upon the plates of clay, it forms, when rubbed up with lime-water, a liquid quite similar to milk. In this casein, and in that precipitated with rennet, the proportion of ash is on an average 8·5 per cent, whilst that precipitated with acetic acid contains only 1·8 per cent, the chief constituent of which, in the latter case, is di-hydro-calcium phosphate, whilst in the two former it is neutral tri-calcium phosphate. The above observations confirm the view of Hoppe-Seyler, of Soxhlet, and Hammarsten, that casein exists in milk not in solution but merely in a strongly swollen state. If dissolved it would be absorbed by the clay plates like the albumen. The same observations prove that the fat-globules in milk are not enveloped in capsules of solid matter, since the fat exudes at a gentle heat, and can be readily washed away with ether. The application of these observations to the quantitative determination of casein and milk-sugar depends, in the first place, on the existence of earthenware plates with pores so fine as not to absorb the milk-globules as such. The author has been able to procure such plates from one firm only. The method of performing the analysis is as follows:—Suitable plates, after having been heated for some time to about 100° and cooled again, are held in a sloping position, quickly drenched with a thin stream of water upon their smooth surface, and placed on a glass vessel of suitable width, the bottom of which is covered with a thin layer of concentrated sulphuric acid. The milk in question, previously diluted with an equal weight of distilled water, is cautiously run upon the middle part of the plate in a connected layer by means of a small glass syringe, and covered with a smooth-edged glass capsule to prevent evaporation. To ascertain the weight of the portion taken for analysis the syringe is weighed both before and after pouring the milk upon the plate. From 9 to 10 grms. of diluted milk are sufficient. After the lapse of one to two hours the serum will be found to have been absorbed to such an extent that the cake can be removed by means of a sharp horn spatula specially designed by the author for this purpose, and placed in a balanced watch-glass. This residue is then dried in the air-bath at 105°, which can be completed in two hours, and weighed. In this manner the joint weight of casein and fat is obtained. The dry matter, without being previously pulverised, is placed upon a tared filter, dried a 105°, by means of forceps, and washed in the first place with a small quantity of ether. It is then thrown into a small smooth glass mortar provided with a spout, and most finely pulverised with the addition of a few drops of absolute alcohol, ether is added, so as to wash the whole

into the filter, where it is further washed till completely free from fat. After the evaporation of the filtrate of alcohol and ether the fat remains in the small flask, which must be previously tared, and which is weighed again when the evaporation is completed. In order to determine the casein, it is merely needful to dry the filter with the residue as long as any loss of weight takes place, and then to weigh. As the casein contains a considerable proportion of ash this must be separately determined and deducted. The casein thus obtained, on being submitted to ultimate analysis by the soda-lime process, was found to contain 15·57 per cent of nitrogen as calculated for the pure substance free from ash. On comparing the results with those obtained by Hoppe-Seyler's process the amount of casein appears greater according to the former, especially as in the latter method a part of the precipitate obtained with acetic acid is re-dissolved on washing. The 1·8 per cent of ash contained in the casein obtained on Hoppe-Seyler's method has hitherto been left entirely unnoticed. The author announces that as soon as a stock of suitable clay plates have been prepared he will give the address of the firm from whom both these and all other articles required for the execution of the process may be obtained.

New Derivative of Sulpho-urea: Sulph-hydantoic Acid, or Sulpho-carbamid-acetic Acid.—R. Maly. – Not suitable for abstraction.

MISCELLANEOUS.

Royal Institution of Great Britain.—At the general monthly meeting, held on Monday last, the following arrangements of the Lectures before Easter, 1878, were announced:—

Prof. Tyndall, D.C.L., F.R.S.—Six Lectures adapted to a Juvenile Auditory, on Heat, Visible and Invisible; on Dec. 27 (Thursday), 29, 1877; Jan. 1, 3, 5, 8, 1878.

Prof. Alfred H. Garrod, M.A., F.R.S.—Twelve Lectures on the Protoplasmic Theory of Life and its Bearing on Physiology; on Tuesdays, Jan. 22 to April 9.

James Dewar, M.A., F.R.S.—Twelve Lectures on the Chemistry of the Organic World; on Thursdays, Jan. 24 to April 11.

R. Bosworth Smith, M.A.—Seven Lectures on Carthage and the Carthaginians; on Saturdays, Jan. 26 to March 9.

Rev. W. Houghton.—Three Lectures on the Natural History of the Ancients; on Saturdays, March 10, 23, 30.

Ernst Pauer.—Two Lectures on the Clavecinistes and their Works (England and Italy; France and Germany); with Musical Illustrations; on Saturdays, April 6, 13.

Prof. Tyndall will give a Course of Lectures after Easter.

The Friday Evening Meetings will begin on January 25, at 8 p.m., when Prof. Tyndall will give a discourse at 9 p.m. Succeeding Discourses will probably be given by W. H. Preece, Matthew Arnold, Dr. Philip L. Sclater, Prof. Roscoe, Dr. R. Liebreich, Prof. Goldwin Smith, Lord Rayleigh, Profs. Huxley and Dewar, Sir John Lubbock, and Sir Joseph D. Hooker.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 10th.—Society of Arts, 8. Cantor Lecture. "Manufacture of Paper," Lecture III., W. Arnot, F.C.S.

WEDNESDAY, 12th.—Society of Arts, 8. "Freedom in the Growth and Sale of the Crops of the Farm, considered in its Bearings upon the Interests of Landowners and Tenant Farmers," J. B. Lawes, F.R.S.

SATURDAY, Dec. 15th.—Physical, 3. "On Permanent Plateau's Films," by S. P. Thompson, B.Sc. "On the Coloured Figures Exhibited by Vibrating Fluid Films," by Sedley Taylor, M.A.

TO CHEMICAL MANUFACTURERS AND OTHERS.

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THE CHEMICAL NEWS.

Vol. XXXVI. No. 942.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

Phosphorus and Matches. By Dr. Anton von Schrötter, Master of the Imperial Mint at Vienna.

(Concluded from p. 220.)

In the sister-kingdom of Norway the match trade has also taken root, although on a smaller scale. Amongst the countries in which this manufacture was earliest established and has been remarkably successful, Austria must not be forgotten, although its production is now less extensive than that of Sweden. The exportation of matches, wax-lights, &c., amounted to, in the years—

1870	46,684 kilos.
1871	43,685 ,,
1872	42,436 ,,

The decline of the trade is ascribed to heavy local taxation. There are at present 43 large and 79 smaller establishments in operation.

Other Applications of Phosphorus.—Phosphorus is employed not merely in the match trade but in so many other branches, both in a free state and in numerous compounds, that we cannot undertake their exhaustive description. The scientific chemist uses this element in innumerable investigations, as, *e.g.*, in the preparation of methyl- and ethyl-iodide, which, thanks to the labours of A. W. Hofmann, have become indispensable agents in research, and have found extensive application in chromotechnics. For such purposes amorphous phosphorus is often used instead of the ordinary kind, since its reactions are as a rule less violent.

In pharmacy phosphorus plays also an important part, although exclusively in the shape of one of its oxygen compounds, phosphoric acid. This acid is found to be an excellent medium for introducing into the organism the iron necessary for the formation of blood. For this reason ferric pyrophosphate, which has no inky flavour, and indeed very little perceptible taste, has rapidly become a favourite medicine, and is used in Grimault's iron-syrup, in Löflund's extract of malt, and in so-called "iron-sugar." As a reagent for many substances belonging to the *materia medica* phosphoric acid is also important. According to Kratschmer and Nowak† it is the best test for atropin; according to C. Scheibler‡ there is no better precipitant for nearly all organic bases than phospho-tungstic acid, a combination of phosphoric and tungstic acids equally available for scientific and technological purposes.

Particularly important is the method of Prof. E. N. Horsford, of Cambridge, U.S., for the preparation of bread without yeast, and consequently without fermentation, by means of phosphoric acid. Liebig§ considers this invention "one of the most important and beneficial that have been made within the last ten years." Prof. Horsford who, during his stay in Vienna as an Exhibition juror had the kindness to perform his process in the laboratory of the reporter, proceeds as follows:—White washed bone-ash (3 parts) are treated with about 2·4 parts of sulphuric acid, from which the small amount of lead present in the commercial acid has been previously precipitated by dilution with 10 parts of water. It is thus converted into the well-known calcium phosphate $[CaH_2(PO_4)_2]$, which still contains one-third of the lime in the bones. After removing the gypsum the liquid, which also contains the magnesia of the bones, is concentrated to the consistence of honey, and when cold is mixed with 1 part of starch of any kind, thus forming when thoroughly kneaded together a crumbly mass, which, on exposure to a gentle heat, yields a white dry powder. To this is added bicarbonate of soda in the proportion of 3 parts of the phosphate to 1 of the soda-salt. Dough is now prepared with flour mixed with salt and with the above-mentioned baking powder, worked up well together and baked in the usual manner.

The carbonic acid thus liberated makes the bread light and porous, so that in this respect it differs, if at all, advantageously from that produced with yeast. If bicarbonate of potassa is used instead of the soda-salt the bread has a better flavour, and this procedure would be the more rational, since the greater part of the potash is withdrawn from the flour in the separation of the bran. Hitherto, however, the high price of the potash-salt stands in the way of this improvement. Liebig, however, proposes to substitute a mixture of the bicarbonate of soda and the chloride of potassium in the proportion of about 2 to 1 for the bicarbonate of potassa.

The advantages of a process so easily executed in every household, and the beneficial effects of this well-flavoured bread upon digestion are so evident that it would be superfluous to enter upon any detailed explanation. We may mention, however, that for armies in the field the value of this bread must be incalculable, as it is peculiarly adapted to serve for a time as a substitute for animal food. In America it is already produced in large quantities, and has become a substance of daily consumption. In the recent war it proved very useful. It is evidently possible to incorporate with this bread, by additions suited to circumstances, all the constituents of blood in the necessary proportion.*

We may finally mention that phosphorus notably modifies the properties of metals with which it combines directly, and in the case of such as are strongly electro-positive even with the development of fire. This circumstance has met with technological applications, especially in the case of copper, which, by the addition of 1·2 to 1·5 per cent of phosphorus (phosphor-bronze), becomes harder, tougher, more fluid on fusion, and resists external influences better, *e.g.*, the action of sea-water. A plate of this bronze thus exposed for six months lost only 1·158 per cent of its weight, whilst a plate of the best English copper of equal size lost in the same time 3·058 per cent.

In the works of the Stephenson Tube Company, at Birmingham, phosphor-bronze has been produced on the large scale since 1865, and is used for tubes, barrels for fire-arms of all kinds, cylinders for calico-printing, &c.

Larger proportions of phosphorus render copper white and perfectly brittle. What is the exact part which small quantities of phosphorus may play when alloyed with copper is not quite clear. It may possibly, as Dumas supposes, act principally upon the oxides mixed with the copper, and which, when converted into phosphides may distribute themselves in the mass, thus rendering it harder, tougher, and more elastic.

The phosphor-bronze from the works of G. Höpner and Co., at Iserlohn, is already extensively used for the bearings of axles, for gun-barrels, plating, weights, &c. (See the paper on "Copper" in a subsequent part of this Report.)

If phosphate of copper, obtained by precipitating sulphate of copper with phosphate of soda, is mixed with charcoal and exposed to a strong red heat, a white brittle copper phospide is obtained, very rich in phosphorus, by the aid of which alloys of any desired composition can be most advantageously obtained.

Phosphates have been experimentally used in the glass manufacture, but without any marked benefit. The glass takes a yellow colour.†

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Kratschmer and Nowak, *Wien. Acad. Ber.*, ii., 69.

‡ Scheibler, *Dingl. Pol. Journ.*, cxix., 141.

§ Liebig, *Ann. Chem. Pharm.*, cxlix., 37; *Wagner Jahresber.*, 1869, 470.

* See "Theory and Art of Bread-Making: A New Process without the Use of Ferment," by Prof. E. N. Horsford.

† Pelouze, *Ann. Chim. Phys.*, [4], v., 465.

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.

By H. CARRINGTON BOLTON.

(Continued from p. 250).

II. SULPHIDES.

Mineral.	Formula.	Description.	Locality.
Stibnite	Sb_2S_3	fibrous, massive	Arkansas.
Molybdenite	MoS_2	scalcs	Germany.
Argentite (1)	AgS	with PbS and SiO_2	Virginia City, Nev.
,, (2)		massive, pure	Cornucopia, Nev.
Galenite	PbS	cleavable, massive	Missouri.
Bornite (1)	(CuFe)S	massive	Acton, Canada.
,, (2) and (3)..		two samples, very pure	Harvey Hill, Canada.
,, (4)		massive	Germany.
Sphalerite	ZnS	massive	Friedensville, Pa.
Chalcocite (1) & (3)	CuS	massive	Chili, S.A.
,, (2)		crystals	Bristol, Conn.
Cinnabar	HgS	granular, massive.....	California.
Pyrrhotite (1)	Fe_7S_8	granular, massive.....	North Carolina.
,, (2)		granular, massive.....	Litchfield, Conn.
,, (3)		massive	Anthony's Nose, N.Y.
Niccolite.....	NiAs	massive	Tangerhausen.
Smaltite.....	$(CoFeNi)As_2$	massive	Germany.
Pyrite (1)	FeS_2	massive	Germany.
,, (2).....		massive	Freiberg, Saxony.
,, (3).....		massive	Colorado.
Chalcopyrite (1) ..	$CuS.FeS.FeS_2$	massive	Acton, Canada.
,, (2) ..		massive	Harvey Hill, Canada.
,, (3) ..		massive	Colorado.
,, (4) ..		massive	Ore Knob, N.C.
Ulmannite'.....	$NiS_2+Ni(SbAs)_2$	.....	Petersbach.
Marcasite	FeS_2	crystalline	Germany.
Arsenopyrite	FeS_2+FeAs_2	massive	Norwalk, Conn.
Bournonite.....	$3(CuPb)S+Sb_2S_3$	massive	Germany.
Tetrahedrite	$4CuS+Sb_2S_3$	granular	Freiberg, Saxony.

III. OXIDES.

Mineral.	Formula.	Description.	Local
Cuprite	$\dot{C}u$	massive	Siberia.
Zincite	$\dot{Z}n$	massive	Sterling, N.J

Mineral.	Formula.	Description.	Locality.
Hematite (1)	$\overset{\cdots}{Fe}$	micaceous	Michigan.
,, (2)		red, massive	Missouri.
Magnetite (1)	$\overset{\cdot}{Fe}\overset{\cdots}{Fe}$	massive granular.....	Canada.
,, (2)		.....	Saratoga Co., N.Y.
Limonite (1)	$\overset{\cdots}{Fe_2}\overset{\cdot}{H_3}$	botryoidal	Salisbury, Connecticut.
,, (2)		fibrous	Anniston, Ala.
Franklinite.....	$(\dot{Fe}\dot{Zn}\dot{Mn})(\overset{\cdots}{Fe}\overset{\cdots}{Mn})$	massive	Franklin, N.J.
Chromite	$\dot{Fe}\overset{\cdots}{Cr}$	massive	California.
Uraninite	$\overset{\cdots}{U}\dot{U}$	massive	Bohemia.
Hausmannite	$\dot{Mn}_2\dot{Mn}$	crystalline	Thuringia.
Pyrolusite	$\dot{Mn}$	massive, granular.....	New Brunswick (?)
Manganite	$\overset{\cdots}{Mn}\dot{H}$	crystalline	Ilefeld, Hartz Mountains.
Psilomelane	$(\dot{Ba}\dot{Mn})\dot{Mn}+\overset{\cdots}{Mn}$	massive	Germany.
Wad	$\dot{R}\dot{Mn}+\dot{H}$	earthy	Saxony.
Brucite	$\dot{Mg}\dot{H}$	foliated	Texas, Pa.

(To be continued).

NOTE ON THE DETECTION OF MINUTE TRACES OF BISMUTH.

By FREDERICK FIELD, F.R.S.

In the Chemical News (vol. xxxvi., p. 249) Mr. Hutchings has written an interesting paper upon the detection of bismuth by Von Kobell's test, proposing as a modification the employment of cuprous iodide in place of potassium iodide, finding that the mixture of the former salt with sulphur has not only the advantage of being non-deliquescent, but is superior for use with the test. Mr. Hutchings proceeds to state "that the value of this test of Von Kobell is very great: it deserves to rank as one of the best—in some cases the best—test for bismuth."

Although far from undervaluing the observation of Von Kobell, or the modification proposed by Mr. Hutchings, I think when it is termed the *best* test, and as little as 0·2 or 0·1 per cent can be detected by it in many cases, the writer of the paper must have overlooked a somewhat exhaustive notice on "Some Results of the Analysis of Commercial Coppers" by Prof. Abel and myself, wherein the detection of bismuth is fully entered into, and showing how excessively small quantities of that metal are easily recognised.

The paper was read before the Chemical Society as far back as the year 1862 (see *Journ. Chem. Soc.*, vol. xiv., p. 290). The authors say—"As regards the qualitative examination for bismuth in copper, considerable advantages, in point of delicacy and rapidity of execution over the quantitative method described in a former part of this paper, are possessed by a mode of testing for that metal, which is based upon a curious reaction exhibited by iodide of potassium in the joint presence of bismuth and lead, and which we believe has not hitherto been noticed. When iodide of potassium is added to a solution of a lead salt it is well known that yellow iodide of lead is precipitated, which dissolves on heating the liquid, and is re-precipitated on cooling in brilliant golden-coloured scales. (The solution of the amorphous iodide may be greatly facilitated by the addition of a small quantity of hydriodic acid.) If the least trace of bismuth is present in the lead salt the precipitated scales are no longer yellow, but assume a dark orange or crimson tint, varying in intensity of colour according to the amount of bismuth present. This test is of such extraordinary delicacy that 0·00025 of a grain of bismuth may be detected in copper with the greatest ease, the iodide of lead becoming dark orange, while 0·001 grain imparts a reddish brown tinge and 0·01 grain a bright crimson, the scales resembling chromate of silver in appearance. The mode of operation in applying this test is as follows:—About 100 grains of the copper to be examined are dissolved in nitric acid, a solution of nitrate of lead, equal to about 5 grains of the salt, is added, and subsequently ammonia and carbonate of ammonia. The solution is washed with ammoniacal water, and dissolved in warm acetic acid. Considerable excess of iodide of potassium is introduced, and the liquid is warmed until the precipitate disappears. On cooling, the crystalline scales will show by their colour the presence or absence of bismuth."

By this most delicate test bismuth has been found in coppers hitherto regarded as quite free from the metal. Nearly all the modern copper coinage, more especially that of George III. and IV., contains very considerable traces, and in the new bronze currency it is abundantly evident. It has been found in copper rolled out to a ribbon, and in all copper gauzes, wire and foil.

It appears from this that bismuth is very universally disseminated, and further researches proved that it exists in nearly all specimens of blister, bar, and refined copper from Chile, Mexico, Australia, North America, Buenos Ayres, Manilla, Spain, Russia, Sweden, Norway, Italy, and Hungary, and in nearly all copper money, from that of the present day to the Bactrian coins (181 B.C.).

One of us still further experimented upon specimens of cupreous ores from nearly every part of the world, and although in the carbonates ,atacamite, &c., bismuth was never found, it was almost universally discovered in the simple and double sulphides.

I may be pardoned for recapitulating experiments made many years ago, as I feel certain the test proposed by Prof. Abel and myself is of far greater delicacy than that

recommended by Mr. Hutchings. I am engaged at present upon the detection of bismuth in the non-cupriferous English minerals.

THE DERIVATIVES OF BENZENE.

By P. T. MAIN

THE subjoined extension to all the substitution-derivatives of benzene of the plan alluded to in the twelfth edition of "Fownes's Chemistry" (pp. 423, 424: Organic Chemistry) for distinguishing the varieties of di-derivative—without direct reference (in the propositions deduced) to the supposed position of the replaced atoms of hydrogen in the benzene ring—may be interesting to some readers of the CHEMICAL NEWS. By enabling a student of isomerism among the aromatic compounds to dispense with unsuggestive prefixes such as para, ortho, and meta, and bewildering collocations of numerals such as (1 : 2 : 4), (1 : 2 : 5), (1 : 3 : 6), and to use in place of these only the very suggestive distinguishing marks—as will be seen—(1), (2), (3), it may even be found practically useful.

When hydrogen is replaced twice in the benzene ring there are three varieties of *di-derivative*, according as the two hydrogens replaced occupy symmetrical, consecutive, or unsymmetrical positions; call these di-derivatives respectively (1), (2), and (3) di-derivatives.

Similarly, there are three varieties of *tri-derivatives*, according as the three hydrogens replaced occupy symmetrical, consecutive, or unsymmetrical positions; also three varieties of *tetra-derivative*, according as the four hydrogens replaced have a symmetrical, consecutive, or unsymmetrical arrangement on the benzene ring. Distinguish these three varieties of tri-derivatives as (1), (2), and (3) respectively, and similarly the three varieties of tetra-derivative. The following propositions are then easily proved by referring to diagrams representing the benzene rings with the positions of the replaced hydrogens marked for the three varieties in each case of di-, tri-, and tetra-derivative.

Proposition I.—A *di-derivative* belongs to variety (1), (2), or (3), according as it is related to (that is, can give rise to or be formed from) *one* only, *two* only, or all *three* of the varieties of tri-derivative. Thus—

(1) di-derivative is related to (3) tri-derivative only.
(2) " " (2) and (3) tri-deriv. only.
(3) " " (1), (2), and (3) ditto all.

Proposition II.—A *tri-derivative* belongs to variety (1), (2), or (3) according as it is related to *one* only, *two* only or all *three* of the varieties, either of the di-derivative or of the tetra-derivative.

Proposition III.—A *tetra-derivative* belongs to variety (1), (2), or (3), according as it is related to *one* only, *two* only, or all *three* of the varieties of tri-derivative.

To show that the above propositions define the derivatives independently of the benzene ring is easy; for in the case where all the hydrogens are replaced by *the same* element or group it is known that there are only three di-, three tri-, and three tetra-derivatives; that is, that each variety consists of one member only for each element, as, for example, chlorine. In this case, then, Proposition I. defines the dichloro-derivative, according as it is related to one only, two only, or all three of the isomeric trichloro-derivatives: and Proposition II. defines, then, the trichloro-derivatives as (1), (2), or (3), according to their relation to the dichloro-derivatives. Similarly, the tetra-chloro-derivatives are defined by Proposition III. by their relation to the tri-chloro-derivatives. And all the other di-, tri-, and tetra-derivatives differ from the (1), (2), (3) di-chloro-, tri-chloro-, or tetra-chloro-compounds in that one, or all the chlorines are replaced by some other element or group.

St. John's College, Cambridge,
December 1, 1877.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 6, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors and confirmation of the minutes of the last meeting, the list of presents to the library was read, and the thanks of the Society voted to the respective donors. The following certificates were read for the first time:—R. Bodmer, T. F. Harris, A. Jamieson, G. E. Stodart, W. Watson.

The PRESIDENT then announced that Prof. Odling was again unfortunately prevented from reading his paper "On Gallium," but that his assistant (Mr. Fisher) was present, and would give an abstract of it to the Society.

Mr. FISHER apologised for the absence of Prof. ODLING, stating that the lecture would have been deferred but for the fact that the specimens had to be returned shortly. He hoped, however, that Prof. Odling would give to the Society some theoretical considerations on the new metal at a future date. The following is a summary of the facts stated:—Gallium was discovered by Boisbaudran August 27 to 29, 1875. It was first obtained in the metallic state in November, 1875. Spectrum consists of two bands in the violet; one brilliant, of wave-length 417, and a feeble band of wave-length 403·3. It was extracted in the first instance from zinc-blende of Pierrefitte, a mine in the Pyrenees, afterwards from a black blende of Bensburg on the Rhine. The latter contains 1 part in 100,000; the former 1 in 400,000. 0·65 grm. of gallium being obtained from 430 kilogrms. of Pierrefitte blende. In appearance it resembles lead, but is less blue, tarnishes slightly on exposure to moist air: it is slightly harder than lead, flexible, malleable, and can be cut with a knife. It is not appreciably volatile at a red heat, and is but slightly attacked by oxygen at that temperature. Its specific gravity is 5·9; when fused 6·08. It melts at 30·15° C., presenting a brilliantly white appearance. When once fused it remains liquid, even for several months, at 0° C., but is immediately solidified when in this condition by contact with solid gallium. In consequence of this curious phenomenon of surfusion, the element was at first described as a liquid metal. Crystallises in square octahedra. In properties it is more or less intermediate between aluminium and indium. The solutions of its salts give the following reactions:—With ammonia, a white gelatinous precipitate, soluble, but not freely, in excess; potash, a similar precipitate, soluble in excess. Acetate of ammonia, on boiling in a solution free from excess of acid, precipitates a basic compound. Carbonate of baryta easily precipitates the salts of gallium in the cold. The salts already prepared are the sulphate, which is very soluble, but not deliquescent; the chloride, very soluble and very deliquescent, decomposed by a large ex-

cess of water, and the alum. A solution of the latter, on heating, deposits a basic sulphate, which goes up again on cooling.

In reply to some questions by the President and Mr. Groves,

Mr. Fisher stated that no satisfactory determinations of the atomic weight or specific heat of the new metal had yet been made, and pointed out that the small quantity (0·65 grm.) had prevented M. Boisbaudran from fully investigating some other reactions. Specimens of the metal and the alum were exhibited.

The next paper was "*On Nitrification: a Report of Experiments conducted in the Rothampsted Laboratory*," by R. Warington. After pointing out the technical importance of the above process, and our want of knowledge as to the production of nitric acid from nitrogenous organic bodies, the author states that it has been generally assumed when such bodies decay in a porous medium offering a sufficiently large surface for oxidation, that nitrates must necessarily be formed. This view has, however, never been confirmed by exact experiments. In February last Schlœsing and Müntz (*Comptes Rendus*, lxxxiv., 301) laid before the French Academy a paper proving, in their opinion, that nitrification was due to the action of an organised ferment. Their fundamental experiment is the following:—A glass tube, 1 metre long, was filled with a mixture of 5 kilos. of ignited sand and 100 grms. of powdered limestone. Through this mixture a slow stream of sewage filtered, so that it occupied eight days in passing down the tube. During the first twenty days no nitrates appeared in the exit-tube: after this period they could be detected. Their quantity rapidly increased, until no ammonia could be found in the exit water: this continued for four months. A small vessel of chloroform was now placed on the top of the tube, so that the vapour passed down through the soil. (This reagent effectually suspends the action of organised ferments, whilst it has but little effect on soluble ferments; *Comptes Rendus*, lxxx., 1250). In ten days all nitrates disappeared, and the ammonia salts passed through unchanged. After fifteen days the chloroform was withdrawn, but no nitrification took place during seven weeks. 10 grms. of a soil which was known to nitrify were now treated with water, and the washings poured on the column of sand so as, if possible, to seed the soil anew. Eight days after nitrates again appeared as before. The importance of this new theory is clearly very great, so the author has tested it by further experiments in two distinct lines of proof. First. The action of antiseptic vapours in preventing nitrification. Four tubes were filled with moist kitchen-garden soil. Through the first moist ammonia-free air was drawn by an aspirator. Through the second air moist as before, but previously passed through a bottle containing sponge moistened with carbolic acid. The air drawn through the third tube was similarly charged with a little bisulphide of carbon; that through the fourth with chloroform. Two series of experiments were made. At the end of the experiments the nitrates formed in the soil were determined by the method of Crum and Frankland: the results are given in the following table, the experiments lasting 39 and 46 days respectively:—

Nitrogen as Nitrates and Nitrites per Million of Air-dried Soil.

History of Soil.	First Experiment.	Second Experiment.
Original soil	6·12	8·91
Air passed	40·87	50·86
„ with carbolic acid ..	17·20	40·77
„ with carbon bisulphide	6·70	9·75
„ with chloroform	9·48	7·86

The result of these experiments proves that chloroform and bisulphide of carbon effectually prevent nitrification; that carbolic acid is probably effective to the extent in which it comes in contact with the soil. So antiseptics, as a class, are inimical to nitrification. The second line of proof investigated was the possibility of inducing nitrification by seeding with a substance already nitrifying. After several unsuccessful attempts the author succeeded in nitrifying practically the whole of an ammonium salt. Four stoppered pint bottles were taken, and nearly filled with a solution of ammonic chloride (1 c.c. = 0·000025 grm. ammonia), to which a small quantity of acid phosphate of potassium was added. Two of the bottles were seeded with about 1 grm. of surface-soil from a "fairy ring." One unseeded and one seeded bottle were kept in the light, the other two in the dark. In three months' time the seeded bottle in the dark contained abundance of nitric acid and no ammonia; the other three contained plenty of ammonia but no nitric acid. 1 c.c. of the liquid which had undergone nitrification was now added to each of the unseeded bottles, one in the light and one in the dark. 0·005 grm. of acid tartrate of potassium (to supply organic carbon) was also added to each bottle. In a month the bottle in the dark contained abundance of nitric acid; the one in the light was unnitrified. The conclusions of Schlœsing and Müntz have thus been completely confirmed, with the addition of the important fact that darkness is apparently essential to the action of the nitrifying germs.

After the thanks of the meeting had been given to the author for his important communication,

Dr. Gilbert said that it now seemed strange, having the parallel of the acetic acid fermentation, that this important process had remained so long uninvestigated. In his opinion, the experiments of Schlœsing and Warington left no doubt as to the correctness of their explanation of the process. Dr. Gilbert then drew attention to the great variety which has been found to exist in the power possessed by soils and plants to nitrify in different degrees. Thus one soil would nitrify four to five times as much as another under similar conditions.

Mr. Howard said that the value of old nitre-beds as compared with new ones had long been appreciated, but not understood. The paper of Mr. Warington afforded a satisfactory explanation of their value. He would like to ask if any substances, such as spongy platinum, besides the ferment, possessed the power of nitrification.

Mr. Tidy did not quite understand the relative action of light and darkness on the process, as the bottles exposed to the light were for such a long time—*i.e.*, during the night—in darkness.

Mr. Kingzett enquired whether the presence of oxygen was necessary.

Dr. Frankland could but express his admiration of the paper. The subject was one of the greatest importance. He would suggest that some experiments should be made to try and assist the action of these industrious, inoffensive mycoderms. For instance, an acre of soil 6 feet deep will dispose of the sewage of 3000 people, it would be very desirable to increase this nitrifying power five or even a hundredfold, and in his opinion it was quite probable that the rate might be much increased.

Mr. Hartley thought that the strongest evidence of the presence of an organism was the fact that the process would not go on without the presence of organic carbon.

Dr. Armstrong pointed out that all known instances of the action of unorganised ferments could be resolved into simple effects of hydration; in every case there was a splitting up of a complex molecule. With organised ferments, however, a complication in structure was often produced. The absence of nitrification in the bottles exposed to light might be due to the presence of chlorophyl containing organisms.

Mr. Warington, in reply, stated that it was by no means asserted that nitrification could not take place without an organism, but that for the process to go on in soil in this rapid way the presence of the organism was requisite. In answer to Mr. Tidy, he could throw no light on the fact that darkness was necessary for the process. No

attempt had been made to specially agitate the liquids in the bottles. He would not like to say, without further experiment, that the presence of organic carbon was essential for nitrification, but from analogy he should conclude that it would be necessary.

The next paper, "*On Potable Waters*," by E. J. Mills, D.Sc., was read by Mr. Perkin. After a consideration of the processes for determining the organic constituents of water, the author concludes that the process of Frankland and Armstrong must form the philosophical starting-point in an endeavour to solve the problems of water analysis, and refers to it exclusively throughout his paper. He first considers, in an elaborate manner, the errors incidental to this process, and compares them with those found in Gmelin in determinations brought forward as evidence of the composition of various bodies, and finds that the accuracy of the process compares favourably with that of the ordinary combustion process, and may be safely used as a basis of inference. As regards errors, the author discriminates, in blank experiments (*a*), the chemical error due to the introduction of sulphites, and (*b*) the volume error from the addition of *n* cubic centimetres of purified water. The size of the dish used to evaporate the water has a perceptible effect. Thus, with a 3-inch dish, the organic carbon = 0·323; organic nitrogen = 0·024. With a 6-inch dish, C = 0·307, N = 0·034, the carbon diminishing and the nitrogen increasing with the size of the dish. The author then describes a new evaporator, which consists of a cylindrical copper water-bath, with a hemispherical copper cover cooled by a flow of water. The water is contained in a 3-inch glass dish underneath the cover, and is supplied by a constant convectionless feed. A stream of purified heated air is drawn across the top of the glass dish by an aspirator. In an hour, with a current of 1062 litres, 100 c.c. will be evaporated. From a consideration of the analysis in the "Sixth Report of the Rivers' Commission" the author has arrived at three natural constants or ratios of organic carbon to organic nitrogen in potable waters—(*a*) 3·067, $C_{12} \div N_3 = 3{\cdot}429$; (*b*) 2·521, $C_{12} \div N_4 = 2{\cdot}571$; (*γ*) 2·056, $C_{12} \div N_5 = 2{\cdot}057$. In conclusion, the author makes some interesting suggestions as to the origin of the constancy of the composition of the air, the effect of an alteration in the mass of atmospheric oxygen, &c.

The next paper was "*On Some Derivatives of Allylaceton*," by J. R. Crow. The aceton was prepared according to Zeidler's method, diluted with an equal volume of ether, and transferred to a flask surrounded by cold water, and containing a volume of water twice as great as the ethereal solution. The flask was connected with a reversed condenser, and an excess of sodium gradually added. The ethereal solution was separated and distilled, after drying with potassium carbonate. After the ether had distilled over, the remaining liquid came over chiefly at 135° to 140°. After repeated fractional distillations it yielded the pure substance, boiling at 138° to 139°, having the composition $C_6H_{12}O$; sp. gr. 1·842 at 16·2°. It appears to be a secondary alcohol and a homologue of allyl-alcohol. Its acetate was prepared as a colourless liquid boiling at 147° to 149°. A dibromide was also formed by the action of bromine as a slightly brown thick mass, which did not crystallise; it has the composition $C_6H_{12}Br_2O$.

The next communication was "*On a Fourth Method for Estimating Bismuth Volumetrically*," by M. M. P. Muir. It has been shown by Sonchay and Lenssen (*Ann. Chem. Pharm.*, cv., 245) that normal bismuth oxalate on boiling splits up into a basic oxalate of the composition $Bi_2O_32C_2O_3$+aq, but slightly soluble in nitric acid. The author has utilised this reaction for estimating bismuth. An excess of saturated solution of oxalic acid is added to the solution containing bismuth, the precipitate allowed to settle, the supernatant liquid poured off, and the precipitate boiled with water until free from acid. The residue is now dissolved in dilute hydrochloric acid, and titrated with permanganate. The absence of free hydrochloric acid must be secured before precipitating. The results are accurate, and the method is generally applicable.

The next paper was on "*The Gas of the Grotto del Cane*," by T. G. Young. The author has analysed the gas, which contains 61·5 to 71·0 per cent of carbonic acid, the residual air having the composition—oxygen 20·25, nitrogen 79·75. Finot (Chem. News, vol. xxxv., p. 21) states that in the residual air there is more oxygen than in ordinary atmospheric air. The author cannot confirm this statement. The temperature of the eave in some places is as high as 40°.

The last paper was entitled "*Note on Tetrabromide of Tin*," by T. Carnelly, D.Sc., and L. T. O'Shea. A piece of combustion-tubing was bent in the shape of the capitals V and W joined together. In the middle bend some tin was kept melted. Bromine was dropped from a tap-funnel into one of the other bend. The metal burns in the bromine-vapour, and the tin bromide condenses in the third bend. By distillation the body was obtained pure as a colourless liquid, solidifying to a mass of colourless crystals. Melts at 30° C.; boils without decomposition at 201°; does not fume, and is very slowly decomposed in air; dissolves in cold water without immediate decomposition. It gave on analysis—Sn 27·11, Br 72·78. Its vapour-density was found to be 229.

The Society then adjourned to December 20, when the following papers will be read:—"On the Constitution of the Terpenes and of Camphor," by Dr. Armstrong; "Communications from the Laboratory of the London Institution," by Dr. Armstrong; "Hydrocarbons obtained from *Pinus sylvestris*, with some remarks on the Constitution of the Terpenes," by Dr. Tilden; "On Cuprous Chloride and the Absorption of Carbonic Oxide and Hydrochloric Acid," by J. W. Thomas; "On the Action of Reducing Agents on Potassium Permanganate," by F. Jones; "On Citric Acid as a Constituent of Unripe Mulberry Juice," by Dr. Wright and Mr. Patterson.

IMPERIAL ACADEMY OF SCIENCES, ST. PETERSBURG.

November, 1877.

W. Winogradoff, "*Action of Brom-acetyl-bromide on Zinc-ethyl and Zinc-methyl.*" The reaction proceeds slowly in the cold, 1 mol. of $CH_2Br.COBr$ being added to 3 molecules of the zinc compounds. After a few weeks, in the case of $Zn(CH_3)_2$, crystals of $ZnBrCH_3$ are formed on the addition of H_2O, and by distillation methyl-isopropyl-carbinol, $C_5H_{12}O$, is obtained. Zinc-ethyl yields in the same way an alcohol, $C_8H_{18}O$, boiling at 166°.

N. Zinin, "*Amaric Acid and its Homologues.*" This acid, obtained by heating benzamorone with alcoholic potash, is found to possess the composition $C_{46}H_{42}O_6$. The anhydride, $C_{46}H_{38}O_4$, as formed on heating, melts at 140°, and can be distilled. The alkaline salts and the anhydride are decomposed by heating with HKO as follows:—

$$C_{46}H_{38}O_4 + 4KHO = 2C_{10}H_{13}KO_2 + 2C_7H_5O_2K + H_2.$$

The pyro-amaric acid thus formed is almost insoluble in H_2O, melts at 94°, crystallises in prisms, and possesses an exceedingly bitter taste. By heating benzamorone in a solution of HKO in isobutyl-alcohol the author obtains isobutyl-amaric acid, $C_{50}H_{50}O_6$, which closely resembles amaric acid, and forms a similar anhydride, which yields with HKO the acid, $C_{18}H_{19}O_2K$. This fact would show pyro-amaric acid to be isomeric with dibenzyl-acetic acid, $C_6H_4(C_2H_5)C_7H_6.COOH$, while its homologue would be benzyl-isobutyl-benzoic acid.

NOTICES OF BOOKS.

Elementary Chemistry: a Text-Books for Beginners, &c. By S. F. Peckham, A.M., Professor of Chemistry University of Minnesota. Louisville, Kentucky: J. P. Morton and Co.

The colloquial method of conveying instruction to young learners is at least as old as Plato's Dialogues. In modern days it has been successfully adopted by Mrs. Marcet and Dr. Joyce, whose once excellent works have long become obsolete. In the little book before us the narrative form is used, each character—an uncle and his nephews and niece—speaking for himself, the conversational portions being interspersed with descriptive passages. It is, in fact, written in a style that would be most likely to attract young children. The idea, however, though an excellent one, is not always well carried out, for the children ask alternately the most babyish and the most astute questions. In addition to this, the language used by the instructing uncle is frequently such as would puzzle children of a larger growth, although generally speaking its colloquial plainness is to be admired. Another good feature is that the children are often represented as performing the experiments for themselves, although not as frequently as could be wished, seeing that the illustrations are generally of the simplest possible character. In the first part the non-metallic elements are described, Part II. being devoted to the metals, while Part III. treats of vegetable and animal chemistry as applied to physiology and agriculture. The chapters on vegetable physiology and agricultural chemistry are particularly good.

While upon this subject we may perhaps be excused if we take the opportunity of saying a few words upon the present state of elementary scientific instruction. During the last ten years a large number of excellent scientific school books have been issued, but they are all intended for the instruction of boys and girls of twelve or thirteen, or upwards, while the younger children have been left out in the cold. The speech of Sir John Lubbock at Bradford shows that at last educationists are awakening to the necessity of providing scientific instruction for children of tender years. At the various meetings of the Royal Commission on Scientific Instruction Professor Tyndall repeatedly endeavoured to instil into the minds of his colleagues the necessity for beginning a child's scientific training at as early an age as possible, but his words fell flat on his hearers, who looked upon them as the utterances of an amiable enthusiast. Judging by Prof. Peckham's work and Sir John Lubbock's speech it would seem that the good seed had at last begun to germinate. The only pabulum at present administered to young children, which at all resembles scientific instruction, is what is called "Object Lessons." A lump of sugar, for instance, is held up before the children, who name its different qualities. The teacher then describes its origin and manufacture, and the children repeat all that they recollect of the matter simultaneously in a sing-song tone. The manuals for teaching these lessons are always lacking in arrangement, the lessons having neither connection nor sequence. On one day a lesson is given on a fly, the next on Gloucestershire, the third on a piece of black-lead, and the fourth on a feather. The information conveyed is generally obsolete or incorrect. In a manual published within the last year or two black-lead is described as an ore of iron, Nevada is ignored as a silver-producing country, paraffin and petroleum are not even mentioned in the lesson on lamps and candles, and waterproof garments are said to be imported from Quito!

It may be objected that children of from six to twelve are incapable of making experiments and of drawing conclusions from them, but this fact is always forgotten, that the first years of a child's life are a series of experiments from which he draws his own conclusions and acts upon them. Any intelligent boy or girl who can spin a top, thread a needle, bowl a hoop, or fell a seam, can, by judicious suggestions, be led to discover such facts as that the sun warms us, and that the moon does not; that a suspended magnet points to the north; that iron becomes covered with black rust in the fire and with yellow rust in the damp air, and a hundred other facts that they may make their own through the spontaneous exercise of their proper faculties. A child who, by proper questioning and suggestion, has been led to find out for himself that a magnet has two poles possessing different properties has discovered something that is more valuable to him than the mere scientific fact—he has found out that he can teach himself without the intervention of books and teachers.

We cordially welcome Professor Peckham's little book as being the first step in the right direction, although it has a few defects and shortcomings.

Outlines of Modern Organic Chemistry. By C. Gilbert Wheeler, Professor of Chemistry in the University of Chicago. A. S. Barnes and Co., New York and Chicago, 1877.

This is a handy little manual for those students who have already gone through a course of mineral chemistry, and wish to make themselves acquainted with the chemistry of organic compounds. The author very modestly lays no claim to originality, and freely acknowledges his indebtedness to the works of Riche, Miller, Fownes, and other well-known writers. From what the author says in his preface it would appear that organic chemistry has not as yet received in American colleges sufficiently pronounced attention to create a demand for text-books of considerable size or extended scope; he has therefore confined his labours within the narrow limits of some 200 pages. The practical American mind never seems to have taken kindly to the chemistry of carbon compounds, and chemists on the other side of the Atlantic prefer the more definite and simple results to be obtained by the analysis and synthesis of mineral compounds. In *Silliman's Journal*, for instance, the researches in mineral chemistry far outnumber those in organic chemistry proper, and the same may be said of the extracted articles and papers. It is not, therefore, surprising that the American chemists who have made a reputation as workers in the organic branches of chemical science may be counted on the fingers of one hand. The book is clearly and concisely written, but is somewhat disfigured by the lax method of terminology adopted by Professor Wheeler. For instance, in the article on the C_6H_6 series of compounds the word benzine is used indifferently with benzol, although we are afterwards told that the benzine of commerce is not benzol at all, but something else. The homologues of benz*ol*, too, are spoken of as tolu*ene*, xyl*ene*, &c. Again, when we come to the artificial and natural alkaloids, some of the names end in "ia," others in "ine," and a few in "ina." Such changes as these are apt to be productive of sick head-aches in stupid students, whose infirmities are hardly sufficiently considered by the writers of elementary books. The pyridine series of alkaloids is omitted altogether, although they have a peculiar interest attached to them as being metameric with the phenylamine series. The same remark applies to the quinoline series. These, however, are but slight blemishes in an otherwise admirable little manual.

CORRESPONDENCE.

DAVY'S METHOD OF EXAMINING FOR ARSENIC.

To the Editor of the Chemical News.

Sir,—I have made the following experiments to test the delicacy of Davy's method of examining for arsenic. I took 0·05 grm. of dry arsenious acid, and dissolved it in

1 litre of water, and made the more dilute solutions from this. 1 c.c. of solution was used in each test:—

	Solutions.		Results.
(*a.*) 0·00005	grm. AsO_3 to 1 c.c.		Strong stain in half a minute.
(*b.*) 0·00001	,,	,,	Ditto in 2 minutes.
(*c.*) 0·000005	,,	,,	Stain in 2 to 3 mins.
(*d.*) 0·0000025	,,	,,	Doubtful in 15 mins. Manifest in 60 mins.
(*e.*) 0·000001	,,	,,	Full stain in 12 hours.
(*f.*) 0·0000005	,,	,,	Manifest in 1½ hours.
(*g.*) 0·00000025	,,	,,	Faint, but decided stain in 1 hour.

Experiment (*e.*) necessarily stood overnight. From these results it would seem that Davy's test will indicate with certainty an amount of arsenious acid as small as one-quarter of a millionth of a gramme, and I do not think this is the lowest limit.—I am, &c.,

J. M. Merrick.

59, Broad Street, Boston, U.S.A.,
November 21, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academie des Sciences. No. 22, November 26, 1877.

Nature of the Hydrocarbons Produced by the Action of Acids upon Manganiferous Specular White Cast-Iron.—M. S. Cloëz.—The treatment of a white cast-iron containing 0·04 of combined carbon, and about 0·06 of manganese, with hydrochloric acid of sp. gr. 1·12, occasions the formation of gaseous and liquid hydrocarbons, homologues of ethylen, absorbable in bromine, and capable of combining readily with hydrochloric acid. There are also produced formenic compounds insoluble in and not attacked by sulphuric acid. To prevent the ethylenic carbides from combining with hydrochloric acid it is best to treat the cast-iron with sulphuric acid, mixing 1 part of acid at 66° B. with 5 parts of water. A gentle heat may be applied to promote the action. On treating in this manner 200 kilos. of cast-iron the author obtained 640 grms. of oily carbides, condensed in the first washing-bottles; 2780 grms. of bromated ethylenic products; 532 grms. of formenic hydrocarbides isolated by the action of sulphuric acid; 3800 grms. of insoluble residue, supposed to be dry; and, lastly, 408 grms. of oily products extracted from the insoluble residue by alcohol, and separated from the latter by water. The formenic hydrocarbides, which the author describes in the present paper, after purification were submitted to fractionated distillation. The first products went over at 155°, and the temperature rose rapidly to 160°, where it remained for a time stationary. All that passed over below 170° was kept separate, as also the portion volatilised between 175° and 190°, and thus from 20° to beyond 300°. By repeated and delicate fractionations seven distinct products were obtained, with constant boiling-points, and with corresponding chemical and physical properties. All these products are already known, and appear identical with some of those extracted from the petroleum oils by MM. Pelouze and Cahours. They are the highest terms of the formenic series. The first hydrocarbide is the hydride of decyle, $C_{20}H_{22}$, boiling between 155° and 160°. The second, found in small quantity, is the hydride of undecyl, $C_{22}H_{24}$, boiling between 178° and 180°. The remainder are the hydrides of duodecyl, of tri-decyl, of tetra-decyl, of penta-decyl, and of hexa-decyl. The identity of these complex carbides, obtained by the reaction of mineral compounds without the intervention of any life, supports the opinion of certain geologists relative to the origin of the petroleum oils. From a purely chemical point of view, with reference to the synthesis of so-called organic bodies, the reproduction of a great number of these species may be effected from setting out from the ethylenic or formenic hydrocarbides yielded by cast-iron.

Second Note on the Magnetisation of Tubes of Steel.—J. M. Gaugain.—The variations of magnetism produced under the influence of heat in a solid bar of steel do not differ from those produced under the same influence in a system composed of a tube and a nucleus. Both appear to depend on the inverse magnetism developed by the mutual reaction of the concentric layers, whether of the bar or of the system.

Liquefaction of the Binoxide of Nitrogen.—M. Cailletet.—The author has succeeded in liquefying this gas by the pressure of 104 atmospheres at −11°. At +8° the binoxide remains gaseous at a pressure of 270 atmospheres. Pure formen compressed by 180 atmospheres at 7° (+ or − ?) gives rise, when the pressure is suddenly reduced, to a mist, like that which appears when the pressure upon liquid carbonic acid is suddenly diminished. This fact gives the author hopes of effecting the liquefaction of formen. M. Berthelot, in presenting the above communication, called attention to the discovery of Mr. Andrews that there exists for every vapour a critical point of temperature, above which liquefaction cannot be produced by any pressure soever. This critical point, for the binoxide of nitrogen, appears to lie between + 8° and −11°.

Nitrification by Organic Ferments.—MM. Th. Schlœsing and A. Muntz.—In the authors' experiments, whenever a nitrifiable medium remains in presence of chloroform, or has been heated to 100°, and then preserved from atmospheric dust, nitrification has been suspended. But it can be re-animated by introducing into the heated medium a small quantity of a substance such as earth, in which nitrification is active.

Modification of Bell's Telephone with Multiple Membranes.—M. Trouvé.—The author states that the apparatus of Mr. Bell, on ordinary lines, only transmits the voice to relatively short distances in consequence of the weakness of the currents produced by the manipulator. He therefore substitutes for the single membrane of Bell's telephone a cubic chamber, of which each surface, with the exception of one, is formed by a vibrating membrane. Each of these membranes, thrown into vibration by the same sound, acts upon a fixed magnet fitted with an electric circuit. In this manner, by associating all the currents produced by these magnets, there is obtained a single intensity, which increases in proportion to the number of the magnets influenced. For the cube we may substitute a polyhedron, the faces of which are formed of an indefinite number of vibrating membranes, in order to obtain the desired intensity.

Justus Liebig's Annalen der Chemie,
Band 189, Heft 3.

A Contribution to the Knowledge of the Iron-Cyanogen Compounds.—Dr. Z. H. Skraup (Second treatise).—The author describes super-ferrid-cyan-potassium, $FeCy_6K_2$, identical with Bong's black prussiate, and obtained by the action of potassium chlorate and hydrochloric acid upon potassium ferrid-cyanide. If heated with nitric acid it is converted into potassium nitroprussiide. With the salts of barium, strontium, calcium, and aluminium solutions of super-ferrid-cyan-potassium give no precipitates; neutral salts of lead give no precipitate, but take a peculiar blue colour; sugar of lead gives an abundant green precipitate, resembling hydrated chromic oxide; silver nitrate produces a dirty green precipitation, which turns yellow on standing, more rapidly if boiled, and finally turns white, but very slowly; coppe

and nickel are precipitated olive-green; cadmium and manganese, a grey-violet; zinc, a greyish blue; cobalt, a red-brown. Ferric salts give no precipitate, but merely an olive-green colour; ferrous salts produce a characteristic blue-green precipitate. The super-ferrid-cyan-potassium can only be obtained pure in an amorphous condition. Bong's crystallised black prussiate was probably contaminated with potassium sulphate.

MISCELLANEOUS.

Royal Society.—On St. Andrew's Day the Anniversary Meeting of the Royal Society was held. The following officers were elected for the ensuing year:—President, Sir J. D. Hooker, C.B., M.D., D.C.L., LL.D. Treasurer, W. Spottiswoode, M.A., LL.D. Secretaries, Prof. G. G. Stokes, M.A., D.C.L., LL.D.; Prof. T. H. Huxley, LL.D. Foreign Secretary, Prof. A. W. Williamson, Ph.D. Other Members of the Council, F. A. Abel, C.B., V.P.C.S.; W. Bowman, F.R.C.S.; F. J. Bramwell, M.I.C.E.; W. B. Carpenter, C.B., M.D., D.C.L.; W. Carruthers, F.L.S.; W. Crookes, V.P.C.S.; Prof. P. M. Duncan, M.B., F.G.S.; W. Farr, M.D., D.C.L.; Prof. W. H. Flower, F.R.C.S.; Prof. G. C. Foster, B.A., F.C.S.; J. R. Hind, F.R.A.S.; Lord Rayleigh, M.A.; Vice-Admiral Sir G. H. Richards, C.B.; Prof. H. J. S. Smith, M.A.; Prof. B. Stewart, M.A., LL.D.; Prof. A. Thomson, M.D., F.R.S.E. The Copley Medal was awarded to Prof. Dana; the Royal Medals to Profs. Abel and Heer. The Davy Medal was awarded to Profs. Bunsen and Kirchhoff.

University of London.—The following is a list of the candidates who have passed the recent Second B.A. and Second B.Sc. Examinations:—Examinations for Honours, B.A. and B.Sc. conjointly; Logic and Moral Philosophy. First class—J. G. Schurman, B.A., University College, disqualified by age for Scholarship; W. A. Statham, B.A., University College, Scholarship; A. J. Harvey, B.A., University College. Second class—H. W. Trenchard, B.A., University College; L. Cohen, B.A., Jews' Free School; W. J. Spratling, B.Sc., University College and private study. Third class—N. J. Synnot, B.A., Catholic University College, Kensington; C. E. Davis, B.A., private study; C. Warburton, B.A., Old Trafford School and private study; J. Easterbrook, B.A., St. Mark's College, Chelsea. B.Sc. only; Chemistry. Second class—W. L. Wills, Owens College: E. H. Cook, Royal College of Science, Dublin; J. H. Paul, private study. Experimental Physics. Second class—W. L. Wills, Owens College. Third class—E. H. Cook, Royal College of Science, Dublin. Physical Geography and Geology. Second class—A. Simpson, B.A., F. C. Divinity Hall, Aberdeen; A. C. Dixon, private study; W. J. Spratling, University College and private study. Botany. Second class—R. H. S. Spicer. St. Mary's Hospital.

Edinburgh University Chemical Society.—The fourth Annual Meeting of this Society was held on Wednesday, the 28th ult., when the President, Prof. Crum Brown, delivered an address on "The Life and Works of Joseph Black." During last winter session fifteen papers were read at the meetings of the Society, and during the summer session five excursions were made to chemical works. Office bearers for the present year:—President, Prof. A. Crum Brown; Vice-Presidents, W. Inglis Clark, B.Sc., John Gibson, Ph.D., F.R.S.E.; Hon. Treasurer, Charles Maxwell, R.N.; Hon. Secretary, John Adams. This Society has now 52 members on its register, and ten new names were proposed at the last meeting for membership. During the last three winter sessions upwards of thirty papers have been read before the Society, and during the corresponding summer sessions fifteen different chemical works, or other works of interest to chemists, have been visited.

MEETINGS FOR THE WEEK.

SATURDAY, Dec. 15th.—Physical, 3.

MONDAY, Dec. 17th.—Society of Arts, 8. Cantor Lecture. "Manufacture of Paper," Lecture III., W. Arnot, F.C.S.

TUESDAY, 18th.—Manchester Geological Society, 3.

WEDNESDAY, 19th.—Society of Arts, 8. "The Telephone," by Prof. A. Graham Bell.

—— Meteorological 7.

THURSDAY, 20th.—Chemical, 8. "On the Constitution of the Terpenes and of Camphor," Dr. Armstrong. "Communications from the Laboratory of the London Institution," Dr. Armstrong. "Hydrocarbons obtained from *Pinus Sylvestris*, with some remarks on the Constitution of the Terpenes," Dr. Tilden. "On Cuprous Chloride, and the Absorption of Carbonic Oxide and Hydrochloric Acid," J. W. Thomas. "On the Action of Reducing Agents on Potassium Permanganate," F. Jones. "On Citric Acid as a Constituent of Unripe Mulberry Juice," Dr. Wright and Mr. Patterson.

TO CORRESPONDENTS.

Sheffield.—Fresenius's "Qualitative and Quantitative Analysis."

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

NOVEMBER, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Anhydrous Sulphuric.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Clear	0·000	0·007	0·156	0·046	21·10	8·560	0·430	0·94	1·400	14·8	3·00
West Middlesex	Clear	0·001	0·008	0·160	0·042	19·40	8·340	0·390	1·01	1·230	15·3	4·20
Southwark and Vauxhall	Clear	0·000	0·008	0·100	0·053	20·50	8·340	0·360	0·94	1·130	13·7	3·30
Chelsea	Clear	0·001	0·008	0·110	0·042	17·90	7·670	0·430	0·94	1·230	13·2	2·80
Lambeth	Clear	0·000	0·009	0·133	0·053	20·60	9·180	0·390	0·94	1·560	14·3	2·80
Other Companies.												
Kent	Clear	0·000	0·002	0·366	0·003	27·30	11·200	0·610	1·37	4·000	19·4	5·10
New River	Clear	0·000	0·006	0·100	0·050	20·50	9·070	0·320	0·94	0·800	14·0	2·40
East London	Clear	0·001	0·007	0·110	0·032	19·80	8·450	0·360	1·08	1·230	15·4	2·80

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

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CHRISTMAS LECTURES.

Professor TYNDALL, D.C.L., F.R.S.—Six Lectures adapted to a Juvenile Auditory, on Heat, Visible and Invisible; on Dec. 27 (Thursday), 28, 1877; Jan. 1, 3, 4, 8, 1878.

Professor ALFRED H. GARROD, M.A., F.R.S.—Twelve Lectures on the Protoplasmic Theory of Life and its Bearing on Physiology; on Tuesdays, Jan. 22 to April 9.

JAMES DEWAR, Esq., M.A., F.R.S.—Twelve Lectures on the Chemistry of the Organic World; on Thursdays, Jan. 24 to April 11.

R. BOSWORTH SMITH, Esq., M.A.—Seven Lectures on Carthage and the Carthaginians; on Saturdays, Jan. 26 to March 9.

Rev. W. HOUGHTON.—Three Lectures on the Natural History of the Ancients; on Saturdays, March 16, 23, 30.

ERNST PAUER, Esq.—Two Lectures on the Clavecinistes and their Works (England and Italy; France and Germany); with Musical Illustrations; on Saturdays, April 6, 13.

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The Friday Evening Meetings will begin on January 25th, at 8 p.m., when Professor Tyndall will give a Discourse at 9 p.m. Succeeding Discourses will probably be given by W. H. Preece, Esq.; Matthew Arnold, Esq.; Dr. Philip L. Sclater; Professor Roscoe; Dr. R. Liebreich; Professor Goldwin Smith; Lord Rayleigh; Professors Huxley and Dewar; Sir John Lubbock; and Sir Joseph D. Hooker. To these Meetings Members and their Friends only are admitted.

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43	,, ,,	Coke,
10	,, ,,	Sulphate of Ammonia,
2	,, ,,	Sulphuric Acid,
1·50	,, ,,	Chalk,

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THE CHEMICAL NEWS.

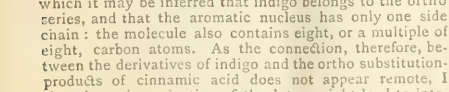
Vol. XXXVI. No. 943.

ON SOME DERIVATIVES OF ORTHO-NITRO-CINNAMIC ACID.

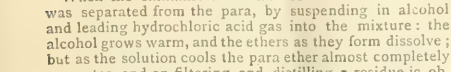
By THOMAS M. MORGAN.

It is some years since Baeyer showed how ortho-nitro-cinnamic acid might be made to yield a small quantity of indol—a discovery of much interest to chemists, since indol is a reduction-product of indigo. This latter substance, when boiled with caustic soda, yields anthranilic acid, and, when fused with the same, salicylic acid, from which it may be inferred that indigo belongs to the ortho series, and that the aromatic nucleus has only one side chain: the molecule also contains eight, or a multiple of eight, carbon atoms. As the connection, therefore, between the derivatives of indigo and the ortho substitution-products of cinnamic acid does not appear remote, I thought an investigation of the latter might lead to interesting results.

When the cinnamic acid had been nitrated the ortho was separated from the para, by suspending in alcohol and leading hydrochloric acid gas into the mixture: the alcohol grows warm, and the ethers as they form dissolve; but as the solution cools the para ether almost completely separates, and on filtering and distilling a residue is obtained consisting of ethyl-ortho-nitro-cinnamate. On digesting the latter with alcoholic ammonium sulphide, there is produced, along with much resinous matter, a crystalline substance which has received the name of carbostyrol. I find, also, that the free acid yields the same product on reduction with tin and hydrochloric acid. carbostyrol has the composition of amido-cinnamic acid minus water; it is deposited in large brilliant prisms by slow evaporation of its alcoholic solution: these melt at 199° to 200°, dissolve in hydrochloric acid, and also in caustic soda, but from the first solution, ether again extracts the substance, and from the second carbon dioxide precipitates it. This weak affinity for acids and bases is explained by supposing that the separation of water from amido-cinnamic acid takes place in the way the following formulæ indicate:—



It has been observed by Chiozza that when carbostyrol is heated with solid potash an oily alkaloid is produced, to which ("Watts's Dictionary," vol. i., p. 802) the formula C_8H_7N has been imputed. On repeating the experiment I obtained from the oil the characteristic reactions of indol, but the quantity formed is small. It is more advantageous to use soda-lime; but even with this, and using 6 grms. of carbostyrol (all I had left), I could only recognise indol in the distillate by qualitative tests. The mixture was heated in a glass tube to a temperature short of redness, much hydrogen was evolved, and the oily distillate contained aniline and indol: it was rendered slightly acid, and again distilled with water; the aqueous distillate was milky, gave a red precipitate with nitric containing nitrous acid, and pine wood moistened with hydrochloric acid was stained red, changing afterwards to brown; when extracted with ether there was left, on evaporation of the ether, an oil of a peculiar disagreeable odour, which, when heated with a little water, solidified on cooling, and re-melted on again gently warming. These were all the tests that I applied. Carbostyrol is thus resolved, by heating with an alkali, into a formiate and indol, a decomposition readily understood if we suppose Baeyer's formula for the latter to be correct.



The yield is necessarily small, as at the high temperature only a small part of the indol escapes decomposition.

Ortho-amido-phenyl-glyceric Acid.

By the process already described for separating ortho- from para-nitro-cinnamic acid, there is, besides the two ethers, at least one other body formed. I have not attempted its isolation at this stage, as it first came under my notice after reduction of the ethers with tin and hydrochloric acid, when, upon addition of common ether, some of it was extracted, and imparted to the ether a beautiful green fluorescence. The fluorescent substance was isolated in this manner. The nitro-acids were regenerated from their ethers and reduced with tin and hydrochloric acid: the mixture was repeatedly extracted with ether, and the tin, which for the most part passes into the ethereal solution, was precipitated therefrom with zinc, and the latter was washed out with water. The ether was next distilled, and the residue dissolved in caustic soda; the solution was saturated with carbon dioxide, so as to precipitate carbostyrol, filtered, and evaporated to dryness. On extraction with alcohol a sodium salt dissolved; it crystallised readily from alcohol, and was by this means purified. An aqueous solution of the sodium salt, on treatment with hydrochloric acid, gives first a yellow precipitate, which an excess of the acid redissolves: the yellow precipitate dissolves freely in hot alcohol, and separates in yellow needles as the solution cools. An analysis was made by taking 7 centigrms. of the substance and heating in a vacuous tube to faint redness, with a known quantity (about six times the weight) of a known mixture of chlorate of potash and manganese dioxide (about 2 per cent of the latter), as it is difficult to effect the complete decomposition of pure chlorate of potash in a sealed glass tube at a dull red-heat. A eudiometric analysis of the gases gave the following numbers:—

	Calculated for $C_6H_4NH_2CHOHCHOHCOOH$.
C 54·9	C 54·9
O 32·3	O 32·5
N 7·0	N 7·1
H 5·8	H 5·5

When used with caustic potash, ammonia was evolved and two acids were produced: the silver salt of the one yielded 64·7 per cent of silver, and it was therefore acetic acid; the sodium salt of the other gave with ferric chloride a violet colour, identical—as was proved by direct comparison—with that produced by sodium salicylate. The substance may therefore be regarded as aniline in which a hydrogen atom in the ortho position has been replaced by a residue of glyceric acid, and may be called ortho-amido-phenyl-glyceric acid. It appears to combine with hydrochloric acid, as the gas passed over the yellow crystals turns them white, and the white compound is insoluble in ether, and may be re-crystallised from a hydrochloric acid solution; but on heating with water a yellow solution is obtained which deposits yellow crystals, identical with the original, on cooling. It melts at 218° with partial decomposition, and sublimes by careful heating; readily dissolves in alcohol, ether, chloroform, and benzene; it is very sparingly soluble in cold water. Its solutions all

possess a green fluorescence, a property also possessed by solutions of ortho-coumaric acid; and the two substances have in their molecular structure considerable resemblance. Of its salts the barium, potassium, and sodium ones were prepared; the first deposits from a hot saturated solution in yellow crystals; the other two are nearly, if not quite, colourless, very soluble in water, but crystallising readily from alcohol. The salts with acids were not examined.

In trying to account for the formation of the substance I have supposed that nitro-phenyl-dichlor-propionic acid first arises from an oxidation of the hydrochloric acid, led into the nitro acids suspended in alcohol, and then—by reacting with water or alcohol—nitro-phenyl-glyceric acid is produced, and this by reduction yields the amido compound.

I hope to be in possession of more material shortly for the further prosecution of this research.

Victoria College, Jersey.

THE DERIVATIVES OF BENZENE.

By P. T. MAIN.

(Continued from p 262.)

In a previous paper it has been shown how the di-, tri-, or tetra-derivatives of benzene may each be distinguished as belonging to one of three varieties, (1), (2), and (3), the significance of these distinguishing numbers being evident from Propositions I., II., and III. in the case in which the hydrogens of benzene are throughout replaced by the same element (or group), *e.g.*, by chlorine.

In the cases in which the hydrogens of benzene are *not* both replaced by the *same* element or group, there are of the di-derivatives only three isomers, one of each of the three varieties (1), (2), and (3); but of tri- or of tetra-derivatives there may be more than three isomers, there being, in fact, two or more isomers of each variety.

The notation, (1), (2), (3), which I propose, is easily applicable to distinguishing all these cases of isomerism. Before illustrating, by one or two examples, how this may be done, it will be desirable to make the following definitions:—

Def.—One di-derivative of benzene is said to *represent* (or be represented by, or be a representative of) another, when either may be converted into the other, or both into a third, by simply varying (through substitution) the replacing element or group.

Def.—A di-derivative and a tri-derivative are said to be *related* to one another, when the tri-derivative (or a representative of it) may be obtained from the di-derivative by replacing one of the remaining benzene-hydrogens of it by an element or group; or when the di-derivative (or a representative of it) may be obtained from the tri-derivative by substituting hydrogen for one of the replacing elements or groups.

When a tri-derivative is related to a (1), (2), or (3) di-derivative by the replacement of its substituted elements or groups by hydrogen, this is conveniently indicated by placing (1), (2), or (3), as the case may be, over that element or group.

Similarly for the relation of a tetra-derivative to tri-derivatives.

Ex.—As an example, *resorcin* has been shown to be related $\overset{(1)}{\underset{}{}}\ \overset{(2)}{\underset{}{}}\ \overset{(3)}{\underset{}{}}$ to nitro-nitro-methyl-benzene, or to $C_6H_3.\overset{(1)}{NO_2}.\overset{(2)}{NO_2}.\overset{(3)}{CH_3}$; which compound is thus indicated as being related to all three varieties (1), (2), and (3) of di-derivative (and to be, therefore, a (3) tri-derivative); to a (1) or (2) nitro-methyl-benzene by replacement of one or other NO_2 by H, and to a (3) di-nitro-benzene by replacement of CH_3 by H.

The constitution of this di-nitro-methyl-benzene was proved thus:—By nitrating toluene two nitro-methyl-benzenes are obtained, which are shown to be the (1) and the (2) nitro-methyl-benzene; one and the same di-nitro-methyl-benzene can be got from both these nitro-methyl-benzenes. This shows that the dinitro-methyl-benzene is related to a (1) di-derivative by the replacement of one of its NO_2 groups by H, and to a (2) di-derivative by replacement of the other NO_2. It is therefore a $\overset{(1)}{\underset{}{}}\ \overset{(2)}{\underset{}{}}$ nitro-nitro-methyl-benzene; and it only remains to find which variety of di-derivative is given by the replacement of CH_3 by H. This is shown to be the (3) variety thus; the nitro-nitro-methyl-benzene has been shown to be related to a (1) di-derivative, viz., (1) nitro-methyl-benzene; but a (1) di-derivative is related to one variety only, the (3), of tri-derivative; hence the nitro-nitro-methyl-benzene is a (3) tri-derivative. But a (3) tri-derivative is related to *all three* varieties (1), (2), and (3) of di-derivative; therefore the replacement of CH_3 by H gives a (3) di-derivative. Hence this compound is $\overset{(1)}{\underset{}{}}\ \overset{(2)}{\underset{}{}}\ \overset{(3)}{\underset{}{}}$ nitro-nitro-methyl-benzene, and its constitution is completely determined. By reduction of this componnd methyl is replaced by hydrogen, and thus a (3) di-amido-benzene is formed, which is represented by a di-nitro-benzene from which resorcin can be got; and thus resorcin is shown to be a (3) di-derivative.

It is, perhaps, necessary to remind the reader of the sense to be attached to the (1), (2), (3) when written over substituted elements or groups, and to warn him that they have nothing whatever to do with the numbering 1, 2, 3, 4, 5, 6 of the corners of the benzene hexagon.

The following example is simpler than the above. It is a problem which was solved by Walker and Zincke:—

Problem.—The (2) and (3) nitro-bromo-benzene when

nitrated give a dinitro-bromo-benzene: is this a (1), (2), *or* (3) *tri-derivative?* Since it is related both to a (2) and a (3) di-derivative by replacing in them H by

(2) (3)
NO_2

it is nitro-nitro-bromo-benzene; it remains to find what variety of di-derivative is got by replacing Br by H. By a reaction involving this replacement a (1) di-derivative was obtained, viz., (1) di-amido-benzene: thus the

(2) (3) (1)

compound is nitro-nitro-bromo-benzene.

The notation I have used might be replaced, without alteration of the method, by the notation (1), (2), (3); or *a*, *b*, *c*; *a*, *β*, *γ*; or 1, 2, 3. The last-mentioned would no doubt be best, were it not for the inevitable confusion with the numbering of the corners of the benzene-ring.

ON THE

ANALYSIS OF VANADIUM SULPHATES AND THEIR DOUBLE SALTS WITH ALKALINE SULPHATES.

By Dr. B. W. GERLAND.

CHEMICAL literature offers but very scanty assistance for the separation and estimation of vanadium, and the few statements made are not always trustworthy. The description of the method I have, after much experience, adopted for this class of vanadium compounds, as the most reliable and expeditious, may under these circumstances be of some interest and service, particularly as the most important part will be generally applicable for all vanadium compounds. Several of the substances I intend to describe in future papers could not be obtained in a pure state, or were too easily affected by oxygen or moisture to allow their trituration and the preparation of a uniform mixture for analysis: it is in such cases necessary to estimate in one sample the greatest possible number of constituents. The task is thereby made more troublesome, and it will be advantageous, when the uniformity of the substance admits, to weigh out several quantities for different determinations.

For the estimation of sulphuric acid, vanadium, and alkalies, the weighed sample is dissolved in water, according to circumstances, with the aid of nitric acid or ammonia, or both. After cooling, the clear solution is acidulated with nitric acid, mixed with lead acetate and alcohol, until all sulphuric acid is precipitated. After a few hours rest, when the lead sulphate has settled, it is filtered and washed with dilute alcohol. No difficulty is experienced if the vanadium is present as tetroxide, but with the pentoxide it often happens that lead vanadate is mixed with the sulphate, and is recognisable by the intense yellow colour of the latter. In that case only the clear liquor is poured off and passed through a small filter, the precipitate treated with a little nitric acid, if necessary heated in a water-bath, then mixed with water and afterwards with alcohol, and allowed to stand for a few hours. The vanadate is generally dissolved by this treatment, and the lead sulphate appears perfectly white; it is now thrown on the same filter, and treated as before. But it does happen, particularly when the precipitation has taken place at a higher temperature, that the sulphate still retains a small amount of vanadate. I have recognised in the ammonium carbonate the most efficient means for separating this small residuum. The solution of this reagent scarcely acts upon the pure lead vanadate; but if the latter is mixed with lead sulphate the former is left intact, whilst the sulphate is rapidly converted into lead carbonate. The solution therefore contains all the sulphuric acid, and only inappreciable traces of vanadium; it is treated with barium chloride in the usual way, and the barium sulphate weighed. The insoluble part, after washing, is heated with acetic acid to dissolve the lead carbonate, and the remaining vanadate is thrown upon the filter already used, washed, and united to the main vanadium precipitate.

The solution from the lead sulphate is neutralised with ammonia, acidulated with acetic acid, and precipitated with lead acetate in small excess. If vanadium tetroxide is present, as shown by the dark colour of the precipitate, it is necessary to oxidise it, and this is readily effected by the addition of bromine water. The precipitate will now be of a bright orange or yellow colour, and very bulky; but heating, assisted by agitation, causes it to contract to a heavy curdy mass. In this condition it can be easily filtered and washed, on a Bunsen's filter, under low pressure. It is of advantage to add a small amount of lead acetate to the wash water. The precipitate is dissolved in nitric acid, the solution treated with sulphuric acid and alcohol, and after a few hours rest separated from the lead sulphate, which after washing is free from vanadium, as Roscoe has already pointed out. The filtrate containing the vanadium is evaporated in a porcelain basin, at a very low temperature (the water-bath at boiling-heat would cause a very lively evolution of gas, and loss, particularly when sulphuric acid was added in great excess), the residuum transferred to a platinum dish, again evaporated, and the sulphuric acid driven off by a careful raising of the heat. All the sulphates of vanadium (those of the trioxide, tetroxide, and pentoxide) leave vanad-pentoxide at red-heat. But this is readily reduced at that temperature by dust, and even by the gases from the lamp: it is therefore necessary to cover the capsule well, and prevent the access of fire-gases, which is best accomplished by the use of a Rose's tube. The heat is then increased to a bright red, which again causes an evolution of gas and leaves a pure pentoxide, whose weight is taken. (If the vanadium sulphates are decomposed at a dark red-heat, until gas-bubbles cease to appear, the pentoxide gives off gas again, when the heat is raised and loses weight amounting to ca. 0·5 per cent.) The platinum vessel suffers in shape by this operation. A dish which I have used very often had originally a flat bottom, but now the latter is pressed out by the vanadium pentoxide, so that the form is hemispherical, and at least 3 m.m. deeper.

The filtrate from the lead vanadate contains, besides the alkalies, a small amount of vanadium. Vanad solutions behave, as I have ascertained, similarly to those of cobalt under the influence of sulphuretted hydrogen; a dilute acetic solution with small excess of free acid, particularly in presence of an alkaline acetate, is slowly acted upon by that gas, and the vanadium precipitated as vanadyl sulphide. If the filtrate therefore is treated with sulphuretted hydrogen, according to Roscoe's direction, the vanadium which it contains will be separated with the lead sulphide: it is on that account preferable to use sulphuric acid and alcohol for the elimination of the lead. The filtrate from this lead sulphate is evaporated, and the residuum heated until the ammonium salts are driven off. The remaining alkalies are dissolved, treated with acetic acid, and once more submitted to the described process for the separation of the small quantity of vanadium with lead acetate. The filtrate from this lead vanadate precipitate is most expeditiously treated with ammonia and sulphide of ammonium at boiling-heat, and the solution separated from the lead sulphide is worked up for the estimation of the alkalies.

The Estimation of Water.—The use of lead oxide, particularly for those compounds which do not allow of intimate mixture, offers great difficulties; even an incon-

veniently long column was not sufficient to retain the large quantities of sulphur dioxide and trioxide that were evolved. I have used with advantage sodium carbonate, obtained as a very light powder, by heating the acid carbonate to about 300°. From 5 to 10 grms. of this very light powder, in a combustion-tube of 30 c.m. length, are sufficient in every case. When the lower sulphates ($V_2 3SO_4$, $V_2H_24SO_4,2H_2O$, &c.) are to be treated in this way it is advisable to mix the sodium carbonate with potassium chlorate, to prevent sublimation of sulphur. The front of the combustion-tube is supplied with a good plug of asbestos, to avoid the carrying forward of dust into the chloride of calcium tube. The apparatus having been mounted, the whole length of the combustion-tube is warmed, to prevent condensation of water; then the part where the mixture of substance and soda lies is heated to redness, and by degrees the heating is extended all over the tube.

The Estimation of Vanadium by Titration with Permanganate.—The first condition is the conversion of vanadium to a certain stage of oxidation. Aqueous sulphurous acid converts vanad-pentoxide in solution to tetroxide, which is perfectly unchangeable in acid liquors, so that these can be boiled for the repulsion of the excess of sulphur dioxide. The tetroxide solutions undergo a further reduction, which if not guarded against might make the test fallacious. I shall shortly be able to refer more fully to this process, but will mention here briefly that the tetroxide in solution, containing an excess of sulphuric acid, is converted into vanadium trioxide by carbonaceous matter (which is introduced by alcohol or with dust), and by sulphur at a temperature of 120°, and that at higher temperatures (about 150°) the acid vanadic sulphate, $V_2H_24SO_4,2H_2O$, separates in the form of insoluble needles, and at ca. 200° the yellow vanadic sulphate, V_23SO_4, appears as a heavy amorphous sediment mixed with the former. If such conditions are apprehended it is necessary to add permanganate until the test-solution remains pink after boiling, as proof that all vanadium is oxidised to the pentoxide; then to treat with sulphurous acid, and, after expelling the excess, titrate again with permanganate.

The colouration obtained by the permanganate generally disappears after a short time, and is reproduced by the first drop of this solution, to bleach again, and so on, until, after a large quantity (up to 20 per cent of what was used to produce the first pink) has been added, the solution becomes opaque by the separation of manganic peroxide. In every case the first appearance of the pink colour is the indication that all vanadium is converted into the pentoxide, and the quantity of permanganate used corresponds exactly with that required by an equivalent quantity of oxalic acid. In hot solutions the first appearance of pink is permanent. The reaction of the permanganate solution takes place instantaneously; the colour changes from blue, through green, to yellow and pink, indicating at every stage the quantity of the standard solution required. The titration of vanadium with a standard solution of permanganate is in fact one of the most elegant, expeditious, and accurate methods of volumetric analysis.

STANDARDISING PERMANGANATE SOLUTION WITH VANADIUM.

By Dr. B. W. GERLAND.

THE stability of the acid solutions of vanad-tetroxide and their beautiful reaction with permanganate, referred to in the preceding paper, recommend them as convenient for the valuation of this oxidising test-liquor. The following three vanadium compounds can easily be obtained pure, and in fit condition for weighing:—Ammonium-vanadate, $AmVO_3$; the insoluble vanadylous sulphate, $V_2O_22SO_4$; and the pentoxide, V_2O_5. The first dissolves readily; the sulphate becomes soluble in sulphuric acid, after treatment with soda; and the pentoxide is dissolved by digestion with hot, dilute, sulphuric acid. The solution is mixed with sulphuric acid, treated with sulphurous acid, boiled to expel the excess, and is then perfectly stable. The high price of vanadium compounds is scarcely an obstacle, as the same quantity can be used repeatedly. I have four solutions, containing vanadium equal to ca. 2·3 grms. to 0·23 grm. vanad-pentoxide, in spacious flasks, protected against dust, which have been oxidised with permanganate and reduced with sulphurous acid perhaps a hundred times during several years, without removal of the solutions from their vessels, and still give the reaction as accurately as when first prepared. The larger quantity corresponds with ca. 50 c.c. demi-normal permanganate solution.

Macclesfield.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

December 15, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidates were elected Members of the Society:—W. E. Ayrton, J. M. Cameron, J. W. Clark, J. E. Judson, B.A., H. N. Mosely, M.A., F.R.S., Lord Rayleigh, M.A., F.R.S., W. N. Stocker, M.A., and H. T. Wood.

Mr. C. W. COOKE read for the author, Prof. S. P THOMPSON, a paper on "*Permanent Plateau Films*," and exhibited the process of their formation. After a brief enumeration of the various attempts made by Plateau himself, Schwartz, Mach, Rottier, and others, most of which are described in the work of Plateau, the author described his own experiments on the subject. As the result of these, he concludes that the best results are obtained by using a mixture of 46 per cent of pure amber-coloured resin and 54 of Canada balsam, which should be heated to from 93° to 95° C. The frames for forming the films are made of brass wire, 0·3 m.m. in diameter, and when thicker wire is employed the films are found to be irregular, in consequence of the retention of heat by the metal. The films are obtained by simply introducing these frames into the heated mixture, and they harden almost immediately on exposure to the air; but better results are obtained by slow drying in an air-bath heated up to 80° C., and allowed to cool. In proof of the toughness of the films it was mentioned that a flat circular film 4 c.m. in diameter had supported a 50 grm. brass weight at its centre.

Mr. SEDLEY TAYLOR then exhibited some experiments in illustration of a paper on the colours exhibited by vibrating liquid films, which he has recently communicated to the Royal Society.

Dr. GUTHRIE exhibited a simple lecture illustration of the action of the telephone. Two similar coils of wire are placed, one on the end of a bar-magnet, and the other on a soft iron core. A tin disk, about 3 inches in diameter, is suspended by two threads almost in contact with one end of this latter, and when a similar disk is brought, at regular intervals, against the end of the magnet which is provided with the coil, a distinct movement of the first named disk is observed, which can be easily increased by properly timing the movement of the inducing disk.

PHILOSOPHICAL SOCIETY OF GLASGOW.

Chemical Section.

November 26, 1877.

Professor John Ferguson, M.A., President, in the Chair.

A short opening address was delivered by the President, in the course of which he announced his intention to prepare a more formal presidential address, to be submitted to the Section at a later period of the session. He also made some remarks on a movement which was being made by the Council with the view of raising a "Graham" medal and lecture fund, towards which the sum of fully £150 had already been obtained from a few subscribers.

Mr. John Mactear then read a paper on "*The Regeneration of the Sulphur Employed in the Alkali Manufacture, as conducted at St. Rollox by the 'Mactear' Process.*" After referring to the Leblanc process, and to the fact that the two raw materials, sulphur and lime, are (with trifling exception) both completely lost as waste products, and form a most objectionable refuse material, the author spoke of the objection to the process as still existing, and said—Almost every chemist, even remotely connected with the alkali manufacture, has at one time or other of his career attacked the problem, although in most cases with but scant success. The attention of investigators seems primarily to have been turned in two directions:—

1st. Towards the production and subsequent utilisation of sulphuretted hydrogen from the alkali waste.

2nd. Towards the production of hyposulphites from the sulphur compounds of the waste—thus ultimately leading to the production of sulphur from mixtures of sulphides and hyposulphites by decomposition with hydrochloric acid.

Reference was also made to the labours of Gossage and many other chemists, and he said that of all the processes devised only four—those of Mond, Schaffner, Hoffman, and Mactear—have been worked on anything like a large scale with success; the first and last of these being by far the most successful. The process of Mr. Mond has been described very fully and clearly by the inventor in a paper read before the British Association in 1868, at Norwich, and also in papers read before the Glasgow Philosophical Society, and the Newcastle-on-Tyne Chemical Society. These may be referred to for details. Briefly stated, the process deals with the waste produced in the alkali manufacture, in promoting the partial oxidation of the sulphur and calcium compounds by forcing air through a mass of waste, then washing out the soluble compounds thus formed with water, and decomposing with hydrochloric acid. It was stated by Mr. Mond that the sulphur could be thus recovered at a cost of 20s. per ton. This statement was made before the process had been sufficiently worked on a large scale to enable the cost to be ascertained, and is much under the mark; indeed, when all the elements of cost have been added, it will be found that the cost of one ton of sulphur actually produced will be not much—if any—under 80s. per ton. The "Mactear" process owes its origin to the great nuisance produced by the natural oxidation of the enormous heaps of alkali waste, and its subsequent lixiviation either by rainfall or by springs under the heaps, and differs in the first instance from Mond's process, in that it proposes simply to deal with the drainage liquors from the deposits, and not by any special separate treatment of the waste.

The principle on which all these processes for the recovery of the sulphur have been based is identical, and lies in the decomposition of sulphuretted hydrogen by sulphurous acid, or such decompositions as are to all intents and purposes equal to this.

It is of course necessary that the lime sulphur compounds must be in such proportions that on the addition of hydrochloric acid with proper precaution, there shall be practically no evolution of sulphuretted hydrogen; and in Mond's process it has been found extremely difficult to obtain in practice liquors of the required composition, and if the workmen are at all careless there is apt to be a considerable evolution of sulphuretted hydrogen.

In the "Mactear" process the apportionment of the various sulphur compounds is very simple, and the evolution of sulphuretted hydrogen, except in cases of the most gross carelessness, is very slight indeed. Although this process has until very recently only been in use at the works of Messrs. Charles Tennant and Co., at St. Rollox, yet by it more sulphur has been recovered than by any other process hitherto introduced.

The heaps of alkali waste at the St. Rollox Works have been accumulating for over forty years, and are chiefly deposited on the surface of an old "bog" or "peat moss," which has been formed in a natural basin in sandstone rock. This bog is of large extent, and contains many springs of water, which, rising up under the waste, dissolve out the soluble sulphur compounds, and give rise to a large flow of what is commonly called "yellow liquor," which is a complex sulphide of calcium, holding also in solution free sulphur. This liquor was for many years allowed to flow with the natural drainage of the land into a stream called the "Pinkston Burn," which, after traversing a considerable portion of the city of Glasgow as a covered sewer, falls into the river Kelvin at some little distance from its junction with the Clyde. This burn in its course receives liquid refuse of all sorts other than mere sewage, notably refuse from distilleries, and these being acid, gave off from the sulphide of calcium liquors sulphuretted hydrogen in such quantities as to give rise to a most intolerable nuisance, of which the public had good reason to complain.

After noticing some of the efforts which had been made from time to time to abate or remove the cause of complaint, and urging practical objections to Mond's process as fully tested at Messrs. Tennant and Co.'s Works, the author went on to say:—The very large amount of plant required also, and the fact that it was not found possible to work up by it all the drainage liquors, induced the writer to again carefully study the subject in all its bearings; and after a long series of experiments, many of them, like those of former workers in the same direction, failures, he succeeded in developing the process which has been so successfully worked at St. Rollox, and bears his name.

As has been said, the principle of all the processes for the recovery of sulphur from alkali waste lies in the mutual decomposition of sulphuretted hydrogen and sulphurous acid. The "Mactear" process depends on the decomposition of the sulphides of calcium by hydrochloric acid, in the presence of a source of sulphurous acid.

The process has various modifications, each of which is applicable under special circumstances:—

1st. The drainage liquor usually called "yellow liquor," is mixed with a small proportion of lime, and then treated with sulphurous acid, which it absorbs, giving a small quantity of sulphur. The liquid containing this sulphur in suspension is then decomposed at a temperature of about 140° F. This method gives good results, but is difficult to regulate, and is subject to the same objection as Mond's process, in that it is difficult to regulate the composition of the liquors, even when only a portion of the yellow liquor is treated with sulphurous acid, and then mixed with the remaining portion and hydrochloric acid. It is also, in consequence of this difficulty, apt to give rise to an evolution of sulphuretted hydrogen, and cause a nuisance.

2nd. The modification actually worked for the past five years, is that of using a solution of sulphurous acid in water. This is obtained either from pyrites, or from the refuse sulphur from the process.

Mr. Mactear described this modification at some length, as also the plant required in carrying it out, the cost of the same to produce from 30 to 35 tons of sulphur weekly, and the detailed cost of a ton of the recovered sulphur, namely 6rs., and said that the manufacture of sulphur by this process is a much more profitable means of using hydrochloric acid than is the manufacture of bleaching-powder, and he is of opinion that it will long continue so, because, in the first place, Sicilian sulphur cannot be reduced much below its present price without shutting up some of the mines, and reducing considerably the production there; and, secondly, the effect of the Alkali Acts and recent Royal Commission has been to increase the manufacture of bleaching-powder, and by an excess of production over demand, to keep the price at a point at which it is no longer remunerative to the manufacturer.

So far as the question of removal of nuisance is concerned, this process has been amply successful in dealing with the sulphide of calcium liquors which used to flow into the Clyde from the works at St. Rollox.

3rd. The third modification of this process is intended for use when the liquors are very weak in strength, say 5° to 8° T., in which case the cost of fuel becomes much enhanced.

It consists in obtaining a stronger solution of sulphurous acid by the production of a bisulphite of lime, or at least of a solution of sulphite of lime in sulphurous acid, which is used just as the sulphurous acid solution in the second modification is employed. As the old waste contains large quantities of sulphite of lime, it is utilised in this modification of the process by grinding it in water to a milk and treating this with sulphurous acid; thus obtaining a solution of sulphite of lime in sulphurous acid, and thus reducing considerably the amount of sulphur required to form sulphurous acid. More hydrochloric acid is of course required by this method, but it has great advantages to recommend it.

There can be no doubt, the author remarked, that the application of one or other of the modifications of the "Mactear" process to the waste drainage, from the heaps at the great centres of the alkali trade, such as Widnes and St. Helens, would reduce very greatly the nuisance complained of there. The St. Helens manufacturers have recently decided not to put any acid drainage into the celebrated Sankey Brook, and this will lead to its utilisation in one way or another. The most probable direction for it to take is that of the manufacture of bleaching-powder. Were, for instance, a combination of manufacturers along the course of the Sankey Brook to collect the drainage liquors, pump them to a convenient spot (in which the author's experience of nearly ten years shows there is little difficulty), and treat them with the acid of either one or various works, obtained by arrangement, he is confident the nuisance compained of in that district would be much reduced, and a handsome profit realised by the manufacturers.

CORRESPONDENCE.

CONTRIBUTIONS TO CHEMICAL ANALYSIS.

To the Editor of the Chemical News.

SIR,—M. Sergius Kern has replied to my letter CHEMICAL NEWS, vol. xxxvi., p. 32, criticising his contributions to your pages. Respecting the erroneous percentages of phosphorus and magnesium contained in magnesium pyrophosphate, I pointed out that it might be a typographical blunder, and M. Kern holds that the "error is evident." Unfortunately, however, the error was not evident to the gentleman who abstracted M. Kern's paper for the *Journal of the Chemical Society*.

Of M. Kern's statement respecting the composition of Cr_2O_3 I need say nothing. We all of us make mistakes sometimes, and I should be very sorry to be held responsible for everything I had said and written.

M. Kern adheres to his statement that "H_2S and SO_2 are frequent not only in Russian coal-gas, which in St. Petersburg is made entirely from English coals." In England we sometimes meet with H_2S in the purified gas, but such cases are decidedly exceptional. As H_2S is always present in the crude gas, it is clear that it must co-exist there with the SO_2 alleged to be frequently present in Russian coal-gas. The existence of SO_2 in coal-gas is very curious, as it is not mentioned in any analyses of coal-gas which I can find recorded, and there are reasons for doubting the *possibility* of its presence. Chemists will be indebted to M. Kern if he will strengthen his statement by describing the tests by which he is in the habit of detecting SO_2 in coal-gas.

With respect to M. Kern's discovery of davyum I have nothing to add to my former letter, in which I wrote "I am far from asserting that M. Kern's claim has not a sound basis." Certainly M. Kern's statements then required confirmation, and even now I think the density may be open to correction. But since that time M. Kern has described a number of characteristic properties of davyum, and I sincerely and cordially congratulate him on his discovery, and hope we may soon have the opportunity of inspecting specimens of the "little stranger" and its compounds. The fact that Bunsen had pointed out the probability of the existence of a new metal in the very residue in which M. Kern has found it, was not mentioned with the view of detracting from the discovery, though the analogy which M. Kern traces between the indication given by Bunsen of the *place to look for* a new metal, and the anticipation by Mendeleef of the *probable properties* of eka-aluminium, is not quite so apparent as might be wished.—I am, &c.,

ALFRED H. ALLEN.

Sheffield, December 1, 1877.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

To the Editor of the Chemical News.

SIR,—This Association, of which you gave some account in an article on "Professional Organisation of Chemists," published in the CHEMICAL NEWS, vol. xxxvi., p. 193, is now incorporated, and has begun active operations under Professor Frankland, D.C.L., F.R.S., &c., as President. Up to the present time more than 300 chemists have been elected as Fellows of the Institute by the Council.

In the article alluded to, the statement of qualifications required of candidates for admission to the Institute as Fellows or Associates, is correct, but with regard to the entrance fee to be paid by Fellows, it was resolved at an Extraordinary General Meeting, held for that purpose, that an entrance fee of two guineas shall be paid by every person who shall on or before February 2, 1878, be elected a Fellow of the Association, in addition to the annual subscription; but in the case of all persons elected after that date as such Fellows the entrance fee shall be five guineas, in addition to the annual subscription.—I am, &c.,

CHARLES E. GROVES, Secretary.

Somerset House Terrace, London, W.C.

Determination of Tellurium.—M. L. Kastner.—The tellurium precipitated by sugar is collected on a small filter and washed. It is then transformed into tellurous acid by moistening with a mixture of 2 vols. nitric acid, 1 vol. water, and 3 drops of sulphuric acid per 10 c.c. of mixture. The tellurous acid in acid solution is evaporated to dryness in a porcelain capsule and weighed.—*Zeit. für Anal. Chemie.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Moniteur Scientifique Quesneville.
December, 1877.

Gout and Rheumatism Cured by Salicylate of Soda.—Dr. Héry.—A medical paper of no chemical interest.

New Researches on the Part Played by Alkalies in the Animal Economy.—M. Mialhe.—A lengthy defence of the use of alkaline bicarbonates in diet and medicine. M. Guhler, in an appendix, calls to mind that alkaline cachexia is not altogether chimerical, and adds the caution that before strong doses of alkaline carbonates are prescribed the structural integrity of the kidneys ought to be ascertained.

French Association for the Advancement of Science: Chemical Section:—

1. **Insoluble Sulphur.**—Dr. Brame.—The author points out that the insoluble sulphur discovered by M. C. Deville is simply the vesicular sulphur described by him some years ago. As to the origin of this modification he does not agree with M. C. Deville. He obtains the insoluble sulphur by pouring sulphur, melted and kept at a high temperature, into a bath of bisulphide of carbon, either at the ordinary temperature or at the boiling-point, the maximum product being obtained in the latter case. The mixture should then be allowed to cool gradually, and not rapidly, as M. Deville maintains. He finally states that sulphur is met with in two essentially distinct forms, the one crystalloid, entirely soluble in bisulphide of carbon; and the other, colloid or utricular, insoluble in the same liquid. He considers that his utricular sulphur is identical in nature with the soft sulphur obtained by fusion.

2. **Researches on Piridin, Picolin, and their Derivatives.**—Prof. W. Ramsay, of Glasgow.—From an English source.

3. **Experiments on the Reaction of Anhydrous Bases and Acids.**—M. J. Béchamp.—Already noticed.

4. **Researches on Santonic Acid.**—Prof. Cannizaro.—An account of the action of hydriodic acid, chloride of acetyl, and chlorides of phosphorus upon santonic acid.

5. **Causes of the Production of Beet-root Treacle.**—M. Gunning.—The author mentions that there is no non-crystallisable sugar in treacle, but that all the sugar present is in the state of definite non-crystallisable compounds, from which the water cannot be eliminated.

6. **Separation of a Mixture of Lead, Zinc, and Silver.**—F. Maxwell Lyte.—The ore, ground and calcined, is treated with dilute hydrochloric acid in troughs of resinous wood, into which steam is blown to raise the temperature. The zinc, lead, and silver are thus converted into chlorides, the argentic and a part of the plumbic chloride remaining mixed with the gangue. The liquid is then run off, and allowed to cool, when nearly the whole of the plumbic chloride is deposited. The clear mother-liquid containing zinc chloride and excess of hydrochloric acid is syphoned back into the first tank, where it takes up a fresh quantity of chlorides of lead and silver, the gangue being thus exhausted after three successive decantations. To the entire solution now existing in the second tank scrap-zinc is added, when all the lead and silver is deposited as a metallic sponge. (It must be remembered that silver chloride is soluble in concentrated solutions of lead chloride.) From the residual liquor the zinc is precipitated as oxide by the addition of milk of lime.

7. **Preparation of Pilocarpin.**—M. Petit.—The leaves of jaborandi are exhausted with alcohol at 85°. The extract is distilled, and the aqueous residue first concentrated, and then diluted with distilled water to remove a resinous matter, and filtered. To the filtrate is added an excess of ammonia, and chloroform is then added thrice in succession to dissolve out the pilocarpine. On distilling off the chloroform impure pilocarpine remains behind, and is exactly neutralised with dilute nitric acid. The product, diluted with water and filtered, is evaporated to dryness in the water-bath. It is further purified by being dissolved in alcohol of 95 per cent, boiled, and filtered over animal charcoal. The yield is 5 grms. per kilo. The nitrate of pilocarpine has a rotatory power of +76° for the ray D. The base forms crystalline salts with the hydrochloric and hydrobromic acids.

8. **Process for Extracting Quinidin from the Quinoidin of Commerce.**—Dr. J. E. de Fry.—The hydrochloric solution of quinoidin is heated in the water-bath, and mixed with a solution of caustic soda (containing 40 grms. hydrate of soda per litre) to remove a black resinous matter. From the solution remaining the quinidin is separated, either by means of tartaric acid, or of potassium iodide. The author remarks that all the neutral salts of the cinchona alkaloids have an alkaline reaction.

9. **On Fermentation.**—M. Gunning.—The author's experiments yield no support to the supposed existence of anærobious beings, presumed capable of living without oxygen.

Systems of Chemical Notation.—A letter from M. Berthelot to M. Marignac.—The author, after pointing out that in France no official interference with chemical theories prevails at the universities, &c., maintains that the new school, to him, does not seem to have justified its pretensions. M. Marignac, in his reply, agrees with M. Berthelot that too great weight should not be laid upon questions whose solution will not change the laws and principal theories of chemistry.

Determination of Manganese and Phosphorus in Spiegeleisen.—M. C. Stœckman.—The author finds that iron and manganese cannot be completely separated by a single precipitation. Some manganese always remain along with the iron. It is therefore necessary, after having filtered and washed several times, to re-dissolve the ferric oxide, and to re-precipitate with acetate of soda. Even two precipitations do not suffice for absolute accuracy. As regards phosphorus, the differences in the results are due to the fact that some chemists dissolve the ore in nitric acid, and others in aqua regia, the quantity found being lower in the latter case. The author's procedure is as follows:—5 grms. of spiegeleisen, pulverised, are dissolved in 60 c.c. of pure nitric acid, of sp. gr. 1·2, in a glass beaker, capable of containing 800 to 1000 c.c., and which is covered with a watch-glass. The acid is added by degress. When the mixture ceases effervescing the beaker is set on the sand-bath, so as to bring the contents to a boil. The substance is dissolved in ten minutes at the most, and the solution is then decanted into a porcelain crucible of 200 c.c. capacity, and evaporated to complete dryness on the sand-bath, covering with a watch-glass to prevent spirting. The crucible is then covered with a porcelain lid, and it is carefully heated over the lamp; the lid is then removed, and the heat is raised till all organic matter is burnt off, or at least decomposed. When completely cold, concentrated hydrochloric acid is added, and the crucible, covered with a watch-glass, is heated on the sand-bath till everything is dissolved. The liquid is then filtered into a beaker, and evaporated to approximate dryness, mixed with a little ammonia until the oxide of iron is thrown down, and then again with nitric acid till all is re-dissolved, boiling if needful. When quite cold, 50 to 60 c.c. of molybdenum mixture are added, and it is allowed to stand from twelve to twenty-four hours at a temperature of 30°

to 40°. The yellow precipitate is filtered off, and washed with Fresenius's mixture.

Molybdenum mixture	.. ..	100 parts.
Nitric acid	.. ..	20 ,,
Water	.. ..	80 ,,

Then dissolved in dilute ammonia, and the solution slightly neutralised with hydrochloric acid; when cold, a solution of chloride of magnesium is added, and then ammonia till the liquid occupies a volume of 100 to 110 c.c. The phosphate of magnesia is calcined at a strong heat.

Adulteration of Ground Madder, and of its Preparations.—M. C. Benner.—The ordinary method of sophisticating madder is to substitute for part of the active colouring matter an inert powder, with which either the extract of a dye-wood or a powerful astringent has been incorporated. The spent bark from the tanneries, dried and powdered, and mixed as may be requisite with extract of chestnut, dry extract of pine-bark, Lima-wood or log-wood, or sometimes with various proportions of all these extracts, is the adulterant generally selected. The reagents for detecting this fraud consist of slips of white bibulous paper steeped in a solution of stannic chloride at 2° B., allowed to drain, and laid upon a plate of glass. Another reagent consists of the same kind of paper steeped in solution of copperas at the same strength, drained, and laid upon the glass by the side of the tin-paper. A portion of these papers is dusted over, whilst still moist, with the powder under examination. Upon a second portion of the papers is sprinkled a perfectly genuine sample, and upon a third portion a mixture which the operator has made up with the different extracts in known proportions. After the lapse of fifteen to twenty minutes the under side of the glass is exposed to a gentle heat till the paper is very dry; the adherent powder is then shaken off, and then we examine the spots of various shades which the extracts of dye-woods and of astringents have produced. Pure madder, madder-flower, and garancin produce no spots, but if the smallest quantity of dye-woods or of astringents has been added one or other of the papers will betray the fraud by spots more or less numerous. The green tannin of certain resinous woods, and especially of pine-bark, is not easily detected by this method. The following method may therefore be used:—5 grms. of the madder, &c., in question are weighed out, mixed with 65 grms. of distilled water at 50°, and 35 grms. of commercial alcohol are then added. The infusion is stirred, and let stand for fifteen minutes, then filtered into a porcelain capsule. Strips of filter-paper are steeped in this liquid as uniformly as possible, dried in the air, and when perfectly dry submitted to the following reagents. A paper should always be prepared for comparison with a perfectly pure specimen. The reagents are:—(1.) Acetate of copper obtained by the double decomposition of—

Sulphate of copper	.. ..	10 parts.
Sugar of lead	.. .. ..	10 ,,
Distilled water	.. .. ..	100 ,,

(2.) Acid chloride of tin, prepared with—

Stannous chloride	.. ..	20 parts.
Hydrochloric acid	.. ..	5 ,,
Distilled water	.. .. ..	100 ,,

(3.) Nitrate of silver, at 10 per cent of the salt.
(4.) Copperas, at 10 per cent.
(5.) Carbonate of soda, at 10 per cent.

A piece of white calico is rolled up so as to form a kind of brush, dipped in each of the test-liquids, and with it one or two transverse strokes are made upon the paper saturated with the alcoholic extract. The paper is then allowed to dry for three-quarters of an hour without exposure to the sun. The coloured reactions upon the papers are then compared with those of the standard sample. The better to detect pine-bark, the infusion of the suspected madder may be previously allowed to ferment. 100 grms. of the sample are infused in 375 grms. of water at 40° C.: grms. of beer-yeast are then added, and the mixture is allowed to stand over-night at 40°. In the morning 500 grms. of water at 50° and 200 grms. of alcohol are added, allowed to stand for half an hour, filtered, and in the filtrate slips of paper are steeped, and examined as above. Or slips of filter-paper may be suspended so as to dip into the alcoholic liquid, and left hanging over night. The liquid ascends by capillary attraction, and the colouring matters becoming oxidised give the paper a different shade, according to the nature of the foreign bodies which have been added to the madder.

Experiments on the Formation of Artificial Ultramarine.—M. J. Plicque.—Already noticed.

Bulletin de la Société Chimique de Paris,
No. 11, December 5, 1877.

New Researches on Chemical Phenomena produced by Electricity of Tension.—M. Berthelot.—Ozone is formed equally under the influence of both electricities, the oxygen in each tube only being in contact with the internal armature. The proportions are very variable, but, as a rule, the positive electricity produces in the majority of cases the more ozone. In none of the experiments made with the Holtz machine has the author observed the smallest trace of nitrogen compounds produced from mixtures of oxygen and nitrogen, whether moist or dry. With the effluve of Ruhmkorff's apparatus traces have been observed, but only at the highest tensions. Acetylen, on the other hand, is produced in notable quantity in the vapours of organic compounds inclosed along with nitrogen in tubes containing a metallic armature, influenced by the discharges of the Holtz machine. The absorption of nitrogen by organic compounds is effected equally by both electricities, and at the weakest as well as at the strongest tensions, though the time required in the former case is longer. Along with the nitrogenous compounds there is formed not a trace of ammonia, nitric or nitrous acid, or hydrocyanic acid.

Fixation of Nitrogen upon Organic Bodies, and Formation of Ozone under the Influence of Feeble Electric Tensions.—M. Berthelot.—The author's experiments have been performed with a battery without closing the circuit, and in conditions which may be reduced to a constant difference of potential between the two armatures. The results obtained have been the formation of ozone and the fixation of nitrogen in organic bodies, such as paper and dextrin.

Certain Observations upon the Mechanism of Chemical Reactions.—M. Berthelot.—Already noticed.

Hydrogenation of Benzol and of the Aromatic Compounds.—M. Berthelot.—The author's method for saturating organic compounds with hydrogen is well known to be founded on the use, in large excess, of an aqueous solution of hydriodic acid, saturated in the cold and applied for a considerable time at a heat of 275° to 280°. By this means he succeeds in reducing benzol, &c., to the composition of absolutely saturated carbides, such as hexylen hydride, $C_{12}H_{14}$, volatile about 69°, a compound which he has formerly pointed out as the ultimate term of hydrogenation of benzol, and the identical term of saturation, moreover, both for the fatty and for the aromatic series.

Observations on the Principle of Maximum Work, and on the Spontaneous Decomposition of Hydrated Binoxide of Barium.—M. Berthelot.—Already noticed.

Swedish Correspondence.—P. T. Cleve.—This correspondence comprises accounts of the researches of M. O. Widmann on the chlorated derivatives of naphthalin; a paper by the same author in conjunction with M. Atterberg, on the derivatives of dichlorated *y*-naphthalin; and a memoir on the bromated derivatives of naphthalin, by M. S. Jolin.

Experiments relating to the Formation of Artificial Ultramarine.—J. F. Plicque.—Already noticed.

New Method of Extracting Scammony Resin.—Emile Perret.—The author exhausts the crude pulverised scammony with boiling alcohol, and neutralises the dark alkaline liquid with a few drops of sulphuric acid. The colouring-matters are precipitated as a lake, and the clear supernatant liquid is filtered off; the alcohol is distilled off, and the residual pure resin is dried on the sand-bath, raising the temperature gradually to 104°.

Preparation of Pure Hydrogen.—E. Varenne and E. Hebré.—The authors pass the gas through the following solution:—

Bichromate of potassa	.. ..	100 grms.
Water		1000 ,,
Concentrated sulphuric acid	..	50 ,,

In this manner all traces of sulphur, arsenic, antimony, carbon, &c., are withdrawn.

On Tanning-Woods, and in particular that of Quebracho aspidosperma, and its Application in Dyeing.—M. J. Arnaudon.—In general it may be said that plants whose wood endures in wet soils, experiencing only a slow alteration, contain, in the wood itself, tannin, whether associated with resinous matters or otherwise. Among such woods may be noticed the Quebracho, a tree belonging to the family of the Apocineæ, specimens of which were displayed by various South-American States at the Vienna Exhibition. In Paraguay the wood of the tree has long been in use for dyeing brown shades, though the employment of the wood as a tanning and dyeing agent is of more recent date. It contains a colourable compound, which, under the influence of light and air, is transformed into an orange-yellow dye, and it is also possible to obtain from the same wood a very beautiful yellow colouring compound.

Journal für Praktische Chemie.
Nos. 14 and 15, 1877.

Action of Ethylic Chloro-carbonate on Sodic Cyanide.—P. Bässler.—This reaction yields ethylic cyamido-carbonate, $NH.(CN)(COOC_2H_5)$, and ethylic cyamido-dicarbonate, $N.(CN.)(COOC_2H_5)_2$. The former is a yellowish syrupy liquid, with a strong acid reaction, forming crystalline salts with metals, which is odd in view of its character as a substituted ammonia. It is not very stable, and is decomposed by water into cyanamide, C_2H_5OH and CO_2. The sodium salt forms, with ethylic chloro-carbonate, the dicarbonate, which possesses remarkable crystalline properties, and melts at 32°. A large number of reactions of both ethers are described. Neither of them can be saponified.

Precipitation of Lime with Alkaline Carbonates.—E. Drechsel.—By means of an exceedingly complicated but ingenious apparatus, which is described at length, the author ascertains, in opposition to Hofmeister's statements, that $CaCO_3$ is almost perfectly insoluble in alkaline liquids; that no trace of it is to be noticed on boiling these solutions: and that when $CaCO_3$ does appear in an ammoniacal solution on heating, with complete exclusion of CO_2 from the surrounding air, it is a reaction for carbamic acid.

Some New Carbamates.—E. Drechsel.—The only known compounds of carbamic acid hitherto were the ethers and the ammonium salt. The author has succeeded in preparing salts with K, Na, Ca, and Sr, which show no small degree of stability. They are formed, in general, by passing CO_2 through the solutions of the various bases in a strong ammoniacal solution, and precipitation by the addition of alcohol. The K salt is also formed by passing CO_2 through a solution of potassic ethylate which has been saturated with NH_3. They are all decomposed by heating into cyanates and H_2O:—

$$NH_2.CO.OK = NCOK + H_2O,$$

the salts of the alkaline earths being decomposed, further, into CO_2 and cyanides, and when dissolved in water gradually change into carbonates.

Two New Methods of Preparing Cyanamide.—E. Drechsel.—The first is by adding sodium amide to fused potassium cyanate, $NCONa + NaNH_2 = Na_2CN_2 + H_2O$, which yields disodium cyanide, and explains why CO_2 and NH_2Na do not yield sodium carbamate, the latter being always decomposed by the NH_2Na. The second method consists in heating the cyanates of the alkaline earths, and treatment with HCl—

$$(NCO)_2Ca = CaCN_2 + CO_2.$$

These doubly substituted cyamides, $KNaCN_2$, $BaCN_2$, $CaCN_2$, &c., show a remarkable stability when exposed to heat, but are decomposed by H_2O under formation of the mono compounds.

Action of Ferricyanides on Metallic Silver.—J. E. Eder.—The author has recommended lately the use of a solution of red prussiate and lead nitrate for intensifying silver negatives, and explained the reaction by the equation $2Pb_3Fe_2Cy_{12} + 4Ag = 3Pb_2FeCy_6 + Ag_4FeCy_6$. In reply to an attack of Wartha's on this, he shows that the reaction product of ferricyanide of lead on silver consists exclusively of ferrocyanides of lead and silver in the proportions 3 : 1.

The Three Isomeric Oxy-benzoic Acids.—H. J Smith.—By the action of NH_3 at a high temperature salicylic and paroxy-benzoic acids are decomposed into C_6H_5OH and CO_2, while metoxy-benzoic acid forms the nitrile, $C_6H_9.OH.CN$. The same results accompany the distillation with CNSK, and coincide with the general experience that the ortho and para acids show a great similarity in their chemical deportment, and differ widely from the more stable meta acid. The nitrile of the latter crystallises in colourless laminæ, melts at 82°, and yields a mono-nitro-compound, from which $C_6H_3.OH.NO_2.COOH$ is derived by boiling with alkalies.

Reimann's Färber Zeitung,
No. 44, 1877.

This issue contains a notice of Dr. Seidler's experiments in proof of the innocence of magenta when taken internally in daily doses of from 0·05 to 0·1 grm.

According to Dépiene, a decoction of the bark of *Syzigium Jambolanum*, applied as a topping to vat-blues, increases their permanence. This bark contains 11 per cent of tannic acid, and is capable of being used as a substitute for sumach.

NOTES AND QUERIES.

Davy's Test for Arsenic.—Please let me know through your paper what Davy's test for arsenic is, refered to by Mr. Merrick in your last issue.—ARSENICUM.

Cement.—Will any of your readers inform me of an acid and heat proof cement for repairing broken chemical apparatus or filling up cracks.—O. Q.

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THE CHEMICAL NEWS.

Vol. XXXVI. No. 944.

NOTE ON THE ACTION OF LIGHT UPON SOLUTION OF OXALIC ACID.

By ARTHUR DOWNES, M.D., and THOMAS P. BLUNT, M.A. Oxon, F.C.S.

In the course of an investigation into the physiological action of light upon minute organisms, the results of which are embodied in a paper read before the Royal Society on the 6th inst., we observed that oxalic acid in a solution of decinormal strength is entirely destroyed when freely exposed to sunlight for some time; a similar solution under parallel conditions, with one exception—that the tube containing it was encased in an opaque material—remaining to all appearance entirely unchanged.

The destruction of the oxalic acid in the insolated tube was so complete at the end of two months, when the solution was examined, that it had no action on litmus-paper, and gave no precipitate with calcium chloride; the reaction with potassium permanganate was so slight as to be scarcely appreciable. The nature of the change—whether it be the result of oxidation or of pure disintegration of the molecule—will form the subject of a future enquiry, but we think the fact itself is of sufficient interest for chemists to justify the present communication. One obvious inference of a practical character is that analysts who still use oxalic acid as a standard should protect the solution from light.

Shrewsbury, December 8, 1877.

DETERMINATION OF INDIGO IN THE PRESENCE OF PER- AND PROTO-SALTS OF IRON.

By HUGH M. WILSON.

As the most reliable method for estimating indigo depends upon its oxidation into isatin, &c., by means of an oxidising body, such as permanganate or bichromate of potash, a difficulty naturally presents itself when per- and proto-salts of iron are present.

Having had occasion to analyse a mixture of this description it occurred to me that owing to the precipitation of indigo by the addition of a soluble salt of barium to sulphindigotic acid a complete separation of the iron salts in their normal condition might thus be established.

0·05 grm. of proto-sulphate of iron was accordingly dissolved in water and mixed with 50 c.c. of per-nitrate of iron (which contained 0·135 grm. of peroxide) and to this was added 0·01 grm. of indigotin dissolved in sulphuric acid. Chloride of barium was now added to the mixture, and the precipitate, consisting of indigo and sulphate of barium, filtered off and washed. The filtrate was then titrated with standard permanganate of potash solution, of which it required 18 c.c., being the same amount a previous 0·05 grm. of proto-sulphate of iron had taken for complete oxidation. Ammonia was added to the solution, now containing the whole of the iron as a per-salt, and precipitated peroxide of iron, washed, dried, and ignited.

The weight of the sesquioxide of iron was 0·150 grm., and on deducting 0·015, viz., the amount which existed as proto-salt, the remainder gave the amount of per-salt taken, viz., 0·135 grm. A solution containing the same proportionate amounts of iron and indigo was now titrated with the same permanganate of potash solution previously used for the iron estimation (strength 100 c.c. = 0·165 grm. indigo), 24 c.c. were required to decolourise the indigo, and on deducting 18 c.c. (the amount required by the iron) the remaining 66·6 expressed the value of the indigo, viz., 99 per cent. Thus there was—

	Taken Fe_2O_3.	Found Fe_2O_3.
0·05 proto-sulphate of iron ..	0·0143	0·015
50 c.c. per-nitrate of iron	0·1350	0·135
	0·1493	0·150
	Indigo.	Indigo.
	0·0100	0·0099

Heaton Mersey, December 4, 1877.

COMPOSITION OF GAS FROM LIME-KILNS

By G. CARR ROBINSON and J. STUART THOMSON.

Some time ago a statement appeared in the Chemical News, vol. xxxv., p. 208, to the effect that the gases liberated from lime-kilns consisted almost entirely of carbonic oxide (CO), to the exclusion of carbonic acid (CO_2). As this appeared to us to be contrary to generally accepted opinion, and having lately had facilities offered, we were induced to examine the gases evolved from some kilns in this neighbourhood.

The limestone burnt consists of the varieties known as "blue" and "white." The seam, which is a thick one, runs below a bed of shale, and contains a considerable quantity of organic matter, chiefly of a bituminous character. The subjoined analyses of the two varieties cause them to be classified as what is technically known as "fat."

	"Blue."	"White."
Carbonic acid (CO_2) ..	41·618	43·911
*Lime	51·681	54·077
Magnesia	1·078	traces
Ferrous oxide	0·652	0·656
Alkalies	0·415	traces
Organic matter	1·874	1·243
Silica	2·745	0·482
	100·063	100·369
* Equal to carbonate of lime ..	92·287	96·566

The samples of gas examined were, in both cases, taken from the top of the charge; that marked I. was drawn at 11.30 a.m., one and a half hours after charging, the kiln being then in full operation; that marked II. was drawn at 3.30 p.m., while charging was going on; these periods being selected with a view of giving an idea of the composition of the gases throughout the whole period of reduction.

We would only further remark that carbonic acid (CO_2), carbonic oxide (CO), and oxygen were alone determined, the difference being stated as residue, which may be assumed to consist of nitrogen mixed with small quantities of hydrocarbons.

	Volumes at 0° C. and 760 m.m. I.	II.
Carbonic acid (CO_2) ..	27·04	7·05
Carbonic oxide (CO) ..	8·09	5·76
Oxygen	0·17	4·40
Residue	64·70	82·79
	100·00	100·00

University of Edinburgh.

REPLIES TO INQUIRIES BY THE GERMAN GOVERNMENT AS TO THE WORKING OF THE SALE OF FOOD AND DRUGS ACT.

THE following are questions submitted to the Society of Public Analysts by Dr. Rottenburgh, the Representative of the German Government, and the answers as agreed to at a Special General Meeting of the Society on the 7th inst :—

1. Is the definition of offences in the Sale of Food and Drugs Act a satisfactory one?
   Certainly not; the definition of our Society should be adopted. See *Proceedings of the Society of Public Analysts*, page 2* (a copy of which has been sent to Dr. Rottenburgh).
2. Is it desirable to define adulteration in relation to a fixed standard of composition for each article of food, or should the definition be a general one?
   The definition should be general except as regards the articles mentioned in the "Limits" (see *Proceedings* referred to above, page 2*). Power should be given to the Home Secretary, or some other similar officer as the Central Authority acting on the advice of the Body of Referees, to make such additions to those limits as from time to time might be desirable.
3. Would it be advisable to have several authorities, with power to fix the standards, or would it be better to have only one Central Authority with that power?
   The definition of standards and limits should be embodied in a Schedule to the Act passed by the Imperial Parliament, subject to revision, as before mentioned, by the Home Secretary or some other similar officer, on the advice of the Body of Referees.
4. Suppose an Analyst fixed a certain minimum of standard,—*e.g.*, in the case of milk,—would not all dealers in milk dilute it down to that standard?
   Most probably, but no Analyst should have power to fix such a standard without the consent of the Body of Referees.
5. Has the punishment of imprisonment often been employed, or has the fine been sufficient?
   As far as we are aware imprisonment has only been inflicted in a few cases; fines, if heavy enough, have generally been sufficient, but in many cases the fines are not heavy enough.
6. Would it be advisable to publish the punishments inflicted?
   Yes, at the discretion of the Court.
7. Would it be advisable, besides either money-fine or imprisonment, to authorise the confiscation of the stock which has been found to be adulterated?
   Yes, when possible after conviction, at the discretion of the Court.
8. Ought the retail dealer to be compelled to give the name of the wholesale dealer of whom he purchased the adulterated article?
   Yes.
9. In a case of adulteration found to be *injurious to health*, would it be advisable to provisionally seize the article as soon as the Analyst has given his certificate?
   Yes, decidedly.
10. Would it be advisable to state on the label of a mixed article the percentage of that mixture?
    Yes, the label should state the maximum percentage of foreign ingredients contained in the mixture.
11. Would it be advisable to make the appointment of an Analyst in every district compulsory?
    Certainly.
12. Is it advisable to leave the appointment of an Analyst to the local authority?
    Yes, subject to confirmation by the Central Authority.
13. Have the selected Analysts often been rejected by the Local Government Board.
    Very rarely.
14. In what manner should Analysts be paid?
    By yearly salary for a fixed number of samples; an increased payment to be made if more than that number of samples are analysed, at a fixed fee for each such additional sample.
15. Is it advisable to have Analysts' Districts large or small?
    Large.
16. Has it often happened that several local authorities have the same Analyst, and, where it is so, has it proved successful?
    It has frequently occurred, and is certainly desirable.
17. Does it often occur that a private person prosecutes in adulteration cases?
    Very rarely.
18. Have the provisions of Section 14 of the Act proved sufficient?
    They are open to objection, but have answered moderately well.
19. Have the Analysts' reports been collected?
    Yes, collected and collated by the Local Government Board, and the numerical results published in abstract.
20. Is it advisable for the Analyst to appear in Court, and does that often occur?
    It is advisable that there should be power for either party to call him if required, on payment to him of a suitable fee. It occurs occasionally here.
21. Have the Inland Revenue Chemists often been appealed to?
    In a very few instances.
22. Have they often differed from the Public Analysts?
    In about half the number of the very few cases referred to them.
23. Would it be desirable to have a different Court of Appeal?
    Yes, decidedly. A Body of Referees should be nominated by the Central Authority, and should consist of Analysts of special experience, to each of whom should be deputed the reference in all disputed cases as to a particular article of food, drink, or drugs, —*i. e.*, each referee should have made a special study

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* Extracts from *Proceedings of the Society of Public Analysts* vol. i., p. 2:—

Definition of an Adulterated Article. An article shall be deemed to be adulterated—

(*a.*) In the case of food or drink.

1. If it contain any ingredient which may render such article injurious to the health of a consumer.
2. If it contain any substance that sensibly increases its weight, bulk, or strength, or gives it a fictitious value, unless the amount of such substance present be due to circumstances necessarily appertaining to its collection or manufacture, or be necessary for its preservation, or unless the presence thereof be acknowledged at the time of sale.
3. If any important constituent has been wholly or in part abstracted or omitted, unless acknowledgment of such abstraction or omission be made at the time of sale.
4. If it be an imitation of, or be sold under, the name of another article.

(*b.*) In the case of drugs.

1. If when retailed for medicinal purposes, under a name recognised in the *British Pharmacopœia*, it be not equal in strength and purity to the standard laid down in that work.
2. If when sold under a name not recognised in the *British Pharmacopœia* it differ materially from the standard laid down in approved works on "Materia Medica" of the period of the standard under which it is sold.

Limits. The following shall be deemed limits for the respective articles referred to:—

Milk shall contain not less than 9 per cent by weight of milk solids not fat, and not less than 2·5 per cent of butter fat.

Skim milk shall contain not less than 9 per cent by weight of milk solids not fat.

Butter shall contain not less than 80·0 per cent of butter fat.

Tea shall not contain more than 5 per cent of mineral matters, calculated on the tea dried at 100° C., of which at least 3 per cent shall be soluble in water, and the tea as sold shall yield at least 30 per cent of extract.

Cocoa shall contain at least 20 per cent of cocoa fat.

Vinegar shall contain not less than 3 per cent of acetic acid

of some one or more articles, and all disputed cases in reference to those articles should be submitted to him, and he should be liable, on the application of either party, to be called upon to appear in Court.

24. Has Section 25 of the Act proved successful?
No. Quite abortive.

25. Would it be advisable that the Analyst should state in his certificate simply that the article is "pure" or "adulterated," or would it be better to state the nature of that adulteration exactly?
It would be better to state as exactly as possible the nature and proportion of the foreign admixture.

26. Would it be advisable to empower the police, with the sanction of the magistrate, to visit suspected beer-shops, tea stores, factories, &c., to search?
It is desirable that the police or other officers should have power to enter places wherein it is suspected that articles of food which are unfit for the food of man are kept.

27. What qualifications should an Analyst possess?
Analysts should be thoroughly educated chemists, of practical experience, possessed of sufficient skill in the use of the microscope, and of some general knowledge of the more common kinds of poisons and substances injurious to health. The chief point, however, is that their education as chemists, &c., should enable them out of their own resources to meet difficulties as they arise, and to recognise clearly all cases in which their own general or chemical knowledge or the authorities available are not sufficient to enable a decided opinion to be pronounced on a sample.

LIQUEFACTION OF OXYGEN.

Students of chemistry will be interested by the following telegram from Prof. Pictet, of Geneva, which was received on the 24th inst. by Prof. Tyndall, and which appeared in *The Times* on Christmas day:—"Oxygène liquifié Samedi par acides sulfureux et carboniques combinés. Pression 320 atmosphères. Température 100 deg. Centigrade de froid." Hitherto all attempts to liquefy oxygen have failed.

On the 26th inst. the following paragraph appeared in *The Times*:—"Messrs. Raoul Pictet, of 20, Rue de Grammont, Paris, send us the following extract from the *Journal de Genève*, dated December 23, which bears on the subject referred to in a telegram with which we were favoured yesterday by Prof. Tyndall:—'Une des expériences de physique les plus intéressantes de notre temps vient d'être exécutée à Genève avec un rare bonheur dans les ateliers de la Société pour la Fabrication des Instruments de Physique. Notre concitoyen, M. Raoul Pictet, à réussi à obtenir à l'aide d'appareils ingénieusement combinés la liquéfaction du gaz oxygène, un des elements constitutifs de l'air atmosphèrique. Voici en deux mots les principes à l'aide desquels on a obtenu ce curieux résultat. Par une double circulation d'acide sulfureux et d'acide carbonique, ce dernier gaz est liquéfié à une temperature de 65 degrés de froid sous une pression de 4 à 6 atmosphères. L'acide carbonique liquéfié est conduit dans un tube long de 4 mètres; deux pompes à action combinée produisent un vide barométrique sur cet acide qui se solidifie par suite de la différence de pression. Dans l'intérieur de ce premier tube, contenant, ainsi qu'il vient d'être dit, de l'acide carbonique solidifié, passe un tube d'un plus petit diamètre, ou circule un courant d'oxygène, produit dans un générateur contenant du chlorate de potasse, et dont la forme est celle d'un volumineux obus, aux parois assez épaisses pour prévenir tout danger d'explosion. La pression peut aller ainsi jusqu'à 800 atmosphères. Hier matin, tous les appareils étant disposés comme nous venons de l'indiquer, et sous une pression qui n'a pas dépassé 300 atmosphères, un jet liquide d'oxygène a jailli de l'extremité du tube, au moment ou le gaz comprimé et refroidi passait de cette haute pression à la pression atmosphérique. Ce qui fait le grand intérêt scientifique de cette expérience, c'est qu'elle demontre expérimentalement la vérité de la théorie mécanique de la chaleur, en établissant que tous le gaz sont des vapeurs pouvant passer par les trois états—solide, liquide, et gazeux. Il y a une quinzaine de jours, M. Cailletet avait reussi à liquéfier le bioxyde d'azote, sous une pression de 146 atmosphères et a une tempèrature de 11 degrés de froid. Après l'expérience de M. Raoul Pictet, il ne reste plus que deux gaz qui aient encore échappé à l'epreuve de la liquéfaction, l'hydrogène et l'azote. La belle expérience que nous venons de résumer sera, nous dit-on, répetèe Lundi et les jours suivants, avec quelques légers changements dans les procédés et dans les dispositions des appareils.'"

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 27, 1877.

Dr. R. Angus Smith, F.R.S., Vice-President, in the Chair.

Mr. G. S. Woolley presented to the Society a photographic portrait of Dr. Dalton, enlarged from a Daguerreotype taken by the late Mr. John Parry about the year 1841; and also a photograph of the first prospectus of Dalton's School.

On the motion of Mr. Bailey, seconded by the Rev. W. Gaskell, the thanks of the Society were unanimously voted to Mr. Woolley for his valuable donations.

"*On the Origin of some Ores of Copper*," (Part I.), by Charles A. Burghardt, Ph.D., The Owens College. To endeavour to trace the various ores of copper to one fundamental source, and to study the relationships probably existing between the copper compound and its accompanying minerals, has appeared to me a subject of great interest, in fact one which has engaged my attention for some time. The commonest occurring ore of copper is undoubtedly cuprite (Cu_2O), either independently or more often associated with malachite, azurite, brown iron ore, and native copper. Scarcely a specimen of copper ore can be obtained (with the exception of the sulphides) which does not exhibit more or less cuprite in intimate intermixture with the other ore; whence it must be inferred that all, or almost all, the ores of copper have been formed by aqueous and not by plutonic action, as cuprous oxide is undoubtedly prepared with greater facility by the wet method (that is, from cuprous or cupric solutions) at a comparatively low temperature than by the dry method at a very high temperature. I will briefly state in which way cuprite (that is, the crystallised cuprous oxide) has been obtained by different authors, first by the dry method and secondly by the wet method.

Preparation of Cuprite.

Dry Methods of Preparation of Cuprite.—1. A mixture of 24 parts of cupric sulphate and 29 parts of copper turnings heated to redness in a well-closed crucible furnishes eventually a reddish brown crystalline mass, which is cuprite.

2. A mixture of 100 parts of cupric sulphate and 57 parts of soda crystals is heated until all the water of crystallisation is driven out, the residue powdered finely, and 37 parts of copper turnings are added, and the whole mixture heated in a crucible to a white heat for half an hour. On washing out the cooled mass with water

cuprite of a very fine colour is obtained. (Wöhler and Liebig, *Pogg. Ann.*, xxi., 581.)

3. Crystals of this substance are often obtained in the slags obtained in the smelting of copper ores.

It will readily be observed from the above that an intense heat is requisite for the formation of cuprite by the dry method.

Wet Methods of Preparation of Cuprite.—1. A solution of equal parts of cupric sulphate and grape sugar is mixed with sufficient caustic soda solution to dissolve all the resulting precipitate and then gently heated; cuprous oxide then separates out in the form of a crystalline powder. (Mitscherlich, *Journ. Prakt. Chem.*, xix., 430.)

2. Becquerel (*Comptes Rendus*, xliv., 308) describes a beautiful method which is applicable for the preparation of many minerals. He filled a test-tube with a neutral solution of cupric nitrate, placing a little cupric oxide and a clean strip of copper plate at the bottom, closed the tube air-tight and left it to itself for many months. In this way he succeeded in obtaining small shining cubes of cuprite.

3. A. Kopp (*Jahrb. f. Min.*, 1861, 508) states that if a mixture of solutions of cupric sulphate and ferrous sulphate be treated by an alkaline carbonate, carbonic acid gas is evolved and a mixture of ferric hydrate and ydrated cuprous oxide is precipitated, the latter becoming rystalline after the expiration of some time.

Of the three methods given above that of Kopp undoubtedly furnishes one of the most probable processes by which many large deposits of the so-called tile ore and copper pitchblende have arisen; but there are again many other deposits of cuprite which may easily have been ormed in other ways. I will not discuss at the present ime the various opinions upon the formation of copper ores expressed by some very eminent and competent authorities, but I may mention that Dr. Ferdinand Wiebel, in a lengthy and exhaustive treatise (Das Gediegen upfer und Roth Kupfererz, Hamburg, 1864) concludes that the native metal and cuprite have in *all* cases been ormed from a cupric sulphate solution (obtained by the oxidation of copper pyrites) through its reduction by a solution of ferrous sulphate (also derived from the oxidation of copper pyrites). This statement is doubtless correct in the case of some formations, but there are many others where it is questionable. Gustav Bischoff points out in his "Chemical and Physical Geology" that "It is certain that the contents of a lode are of later date than the adjoining rock, so that it can be shown that these contents originate from the adjoining rock, and if it can be ascertained what compounds of the metal exist in that rock, the previously existing minerals may be distinguished from those of later date; but the determination of this point is attended with great difficulties and is generally impossible." It is a well-ascertained fact that all the ores of copper are found mostly in crystalline rocks or metamorphic rocks derived from them (some ores, however, being found in newer formations); and Struve (*Ueber die Nachbildung der Naturlichen Heilquellen*, Heft 2, 17) has proved in the most conclusive manner that granite, porphyry, phonolite, gneiss, basalt, clay slate, trachyte, &c., contained a more or less appreciable amount of sodium chloride, and it is also well known that nearly every spring water flowing from rocks contains sodium chloride or a chloride of one of the alkaline earths (magnesium chloride). Further, it has been shown by Delesse (*Jahrb. f. Min.*, 1862, 605) that all rocks are *saturated* with water, and it is also a well-ascertained fact that iron pyrites (FeS_2) is disseminated throughout *all* crystalline rocks. Having these facts before me, I made an experiment in order to ascertain what reactions would occur on heating iron pyrites and a solution of cupric chloride together in a sealed tube at a moderately high temperature. Small pieces of pure iron pyrites were placed in a glass tube, then covered with a moderately strong solution of pure cupric chloride, and the tube sealed up and heated for fourteen days at a temperature varying from 135° to 210° C., but the greater part of the time the temperature oscillated between 150° and 170°. On the seventh day the colour of the cupric chloride had become considerably lighter, and a small deposit of violet-red crystalline cuprite was observed adhering to the sides of the glass tube, whilst on allowing the tube to cool it was observed that a very considerable amount of cuprous chloride had crystallised out in beautiful transparent colourless tetrahedrons. On the fourteenth day the tube was opened, as no further changes had taken place, and the contents examined and found to consist principally of cuprous chloride, with a small quantity of unaltered cupric chloride; there being at the same time a good amount of ferric sulphate and cupric sulphate present. The deposit on the glass tube was cuprite. I was unable at the time to make any quantitative determination of the various substances formed in this reaction, and am therefore not prepared to say what the reaction was precisely. Of course the iron pyrites was considerably attacked, but there was no separation of free sulphur; free hydrochloric acid was also present, but not in sufficient quantity to dissolve the small quantity of cuprite formed on the tube. The insoluble crystallised cuprous chloride was carefully washed in distilled water in order to free it from the substances already mentioned, then placed in another glass tube, covered with distilled water, and the tube sealed up and heated for seven days in an air-bath at temperatures varying from 160° to 180°. On the second day a very marked amount of a bright red substance had already formed on the sides of the tube, and here and there minute green spots of a substance somewhat resembling atacamite ($CuCl_2 3CuHO + \chi H_2O$) in colour. This tube was heated at the temperatures given for about two weeks, when it was observed that although the red deposit did not increase in quantity, the cuprous chloride was slowly undergoing decomposition, a black powder having separated out. On opening the tube a smell of hydrochloric acid was perceived. The liquid portion in the tube was poured out, and the solid portion (which principally consisted of unaltered cuprous chloride crystals with a little of the dark-coloured powder) well washed with water. By levigation it was easy to separate the powder from the crystals and to submit it to a further examination. In order to free it completely from cuprous chloride it was heated in a beaker with a solution of ammonium sulphate in water, which dissolved out all the cuprous chloride and left the powder intact; and the latter on being dissolved in nitric acid, did not give any reaction for chlorine, whilst the presence of copper was very evident; hence there is scarcely any doubt about this substance being cupric oxide. The liquid portion contained free hydrochloric acid and cupric chloride.

When the red deposit first commenced to form upon the sides of the tube a small quantity of violet-red crystalline cuprite was undoubtedly also present, but disappeared on the experiment being continued. I dissolved the red deposit in nitric acid and detected the presence of a large quantity of chlorine in the solution, also that of copper. Therefore I conclude that this red substance is the so-called cuprous oxychloride described by Wöhler (*Ann. Chem. Pharm.*, cxxx., 376). On exposing the substance to the air it takes up oxygen, and acquires a beautiful apple-green colour, becoming a cupric oxychloride which has probably the same composition as Atacamite.

Chalcotrichite.—Being desirous of ascertaining what the action of a moderately strong solution of sodium chloride in water would be upon pure artificially-prepared cuprous oxide when heated with it in a sealed tube, I employed the following method, viz.: The tube was heated in an air-bath for five days at a temperature varying from 150° to 180°, when small traces of a green substance (probably atacamite) were observed, the cuprous oxide had become dark brown in colour, and on the sides of the tube there were small beautiful radiating tufts of an orange-red coloured substance closely resembling the prismatic variety of cuprite called chalcotrichite. Continuing to

heat the tube, on the eighteenth day it was opened, when it was found that no further formation of the prismatic substance had taken place, but there was a beautiful deposit of highly crystalline violet-red coloured cuprite on the sides of the tube. The fibrous substance was dissolved in nitric acid (after having been boiled in distilled water for several hours and carefully washed) and tested for chlorine, which was found to be entirely absent, whilst copper was present in large amount; hence there can be no doubt that this prismatic substance was the rare mineral chalcotrichite. From this experiment it is evident that cuprous chloride was formed at first by the reaction between the sodium chloride and cuprous oxide, and this cuprous chloride was decomposed into cuprous oxide again and deposited on the sides of the tube as above described. I shall refer to the importance of the occurrence of chalcotrichite in conjunction with cuprite when I come to consider the origin of all the copper ores in a future paper, and will therefore describe another series of experiments having for their object the direct formation of malachite.

Malachite.—Great difficulty was experienced in carrying out these experiments for any length of time, owing to the frequent bursting of the tubes, due, no doubt, to their being somewhat weakened by the formation of silicates upon the surface of the glass. Pure artificially prepared cuprous oxide was placed in a glass tube and covered with distilled water, saturated with perfectly pure carbonic acid gas, and then sealed up and heated in the air-bath at a temperature varying from 150° to 175°. After heating fifteen days, the tube was opened and allowed to stand exposed to the air, when a thin film of malachite was observed coating the small clumps of suboxide here and there. The action of oxygen was found to be absolutely essential in the production of malachite by this method, there being no sign of any such formation in the tube before it was opened. Thus there can be no doubt that the greater part of the malachite formations have been produced by the action of water containing carbonic acid gas in solution upon cuprous oxide, as the malachite of the Gumeschewskoi Mine, near Ekaterinenburg, in Russia, is found deposited in a dark coloured clay which penetrates a small limestone ridge, the whole formation finally resting upon chloritic slate. I have examined numerous specimens of malachite from all parts of the world, and have always observed strong evidence of the action of water upon them, there being numerous cavities always present, which exhibit deposits of cuprous oxide, or hydrated ferric oxide in their interiors, and occasionally amorphous silica and calcite. Gustav Rose ("Mineralogische-geognostische Reise nach dem Ural, dem Altai, und dem Kaspischen Meere," 1837), was of opinion, after examining the copper formations in the Ural and Altai districts, that the cuprite there was formed by direct oxidation of the metal; and, secondly, that the large malachite deposits were formed from the cuprite. This opinion probably well expresses the actual process which eventually resulted in the formation of malachite, as the presence of the clay surrounding the ore, the limestone formation and the hydrated ferric oxide and hornstone (amorphous silica) shows that the former neighbouring crystalline rocks must have been submitted to the powerful action of water, which in all probability contained carbonic acid gas. Rose does not give (so far as I am aware) any experimental proofs of his theory of the formation of the great copper deposits of the districts above mentioned. I considered it therefore necessary to endeavour to determine experimentally the accuracy of his statement. For this purpose I placed perfectly clean polished strips of chemically-pure copper sheet in a glass tube, and covered them with distilled water saturated with carbonic acid gas; the tube was then sealed up and heated in a water-bath at 100° for some time. In three days I observed a decided formation of a film of cuprous oxide (which was crystalline) upon the metal; on the seventh day there were small particles here and there of a green substance, which was undoubtedly a basic copper carbonate—very probably malachite. On continuing the heating of this tube for a few days longer at the same temperature, a considerable amount of cupric oxide was formed in scales, arising, doubtless, from the decomposition of the malachite, as it is a well-known fact that malachite on being boiled in water, decomposes into cupric oxide, carbonic acid gas, and water. In order to see what effect pure distilled water would have upon metallic copper under similar circumstances, I placed a large strip of clean polished sheet-copper in a tube, covered it with distilled water, and sealed the tube up, heating it in the water-bath as in the previous experiment. I was astonished to find on the third day that the copper was strongly coated with *cupric* oxide, so that it is evident that pure water has a greater chemical action as an oxidising agent than water containing carbonic acid gas. Having thus obtained the results described, I may be allowed to draw some conclusions from them, as regards the primary copper ore, and the eventual formation of the other ores from it, briefly as follows, viz.:—

1. In all probability the crystalline rocks contain disseminated throughout their mass extremely minute quantities of metallic copper (*when perfectly fresh*); Bischoff mentioning many rocks in which small quantities of cupric oxide have been detected, where its presence would never have been expected.

2. By the action of water, or a solution of carbonic acid gas in water, the metallic copper particles were converted *in situ* into one of the three following substances, viz., cuprous oxide, cupric oxide, and malachite.

3. By the action of water partially charged with sodium chloride (derived from the surrounding rock masses), cuprous chloride and cupric chloride were formed and carried down into the fissures below, where, by the action of a heat which need not have exceeded 160°, the *cuprous chloride* (for the cupric chloride would be completely reduced to cuprous chloride by the action of the iron pyrites which is universally present in all crystalline and metamorphic rocks) was decomposed into cuprite and cupric oxide, and deposited in the fissures or lodes. The ferric sulphate simultaneously formed in the reduction of the cupric chloride would eventually decompose into hydrated ferric oxide and accompany the cuprite in the lodes, whilst the free hydrochloric acid formed in this process would readily attack the neighbouring rocks, thus causing the deposition of gelatinous silica in the lodes.

It will now be my next endeavour to study the chemical composition of all the rocks occurring in the immediate neighbourhood of copper mines, and particularly the evidences of decomposition of these rocks at the place of contact with the metalliferous lode, in order to ascertain whether the above conclusions are correct. In a future communication I hope to deal with the statement made by great authorities on this subject, that the sulphides of copper are the primary and oldest compounds of that metal.

NOTICES OF BOOKS.

Nature's Hygiene and its Artificial Imitation. London Sanitas Company.

It is not often that a patented remedy or a prophylactic for any disease can come legitimately under our cognisance. In the pamphlet before us, however, and in the accompanying circulars, certain questions are raised which are of no small scientific importance. Is it, in the first place, an established fact that either the pine, or the eucalyptus, or the sunflower, or any other plant, has the power of rendering a district more healthy, and in particular of banishing zymotic disease? On this point there is a lamentable want of accord among those who have had

opportunity for personal observation. On the one hand we hear most satisfactory accounts of the sanitation of malarious districts in France, Italy, Portugal, Algeria, South Africa, and we believe also in Cuba; but just as we are on the point of admitting the virtues of the blue gum tree, as demonstrated, comes a witness on the other side, and tells us of malaria in Queensland, in the very heart of a eucalyptus forest, where the air is loaded with the supposed health-giving odour. Which of the observers is, then, under a mistake, or in which case did circumstances unknown or unrecognised interfere with the result?

As regards the pine the same discrepancy prevails. There are two villages in Silesia named See and Moholtz, situate in a rather narrow and swampy valley, girt in by heights covered with pine-woods. The resinous odour, during the summer months, is of the loudest; yet it would be difficult to find a spot in the temperate zone more scourged with dysentery. Would the disease be still worse if the pine-woods were cut away?

We have then, again, the case of camphor, which we read has for ages enjoyed an extraordinary reputation as an antiseptic, and which is "to this day worn by thousands of persons as a preservative against fever, cholera, and small-pox." We are perfectly well aware that camphor enjoys this reputation, but what are the precise facts upon which such reputation is founded? It is said to have the power of banishing or destroying low forms of organic life,—without which, indeed, it could not well act as a safeguard against zymotic disease; yet entomologists tell us that they have discovered mites under a lump of camphor, and that as a safeguard against these foes to museums it is far inferior to the oil of aniseed.

"It has been observed," says the writer, "that wooden hospitals are particularly efficacious as inducing rapid convalescence, a fact hardly susceptible of more than one explanation—that the resinous and turpentine-like bodies existing in the wood exhale under ordinary conditions gases grateful to the human organism." But resinous and turpentine-like bodies are by no means equally present in all woods. Is it not very possible that the superior ventilation, and the absence of accumulated malific matter in hastily extemporised wooden hospitals, may have something to do with the rapid convalescence in question?

In short, before explaining the "mysterious agency of certain plants and trees," would it not be well first to place beyond doubt the existence of such an agency, and to ascertain its conditions and limits?

We are next called upon to assist at the obsequies of ozone and the proclamation of its successor. Poor ozone! It has furnished employment to the thoughts of all classes of men, from learned physicians and profound chemists down to enterprising quacks, who have, as usual, had the best of the bargain. And now the truth has been gradually dawning upon us that ozone is, after all, not the great disinfectant, but rather a poison, and that its presence or absence in the atmosphere of any place stands in no decided relation to the sanitary character of the locality. In its stead reigns the compound called by mortals peroxide of hydrogen, but known among the gods as hydroxyl. Mr. Kingzett's merit is stated in the pamphlet to consist in "the identification of its purifying power (*i. e.*, that of peroxide of hydrogen) with that of the pine and the eucalyptus, and the invention of a method of preparation which brings it within the reach of the public." A few lines further we read that "Sanitas owes its disinfecting power to the peroxide of hydrogen, and its preservative power to the camphoric acid and other ingredients." But turning to a "testimonial" bearing the signature of Arthur Hill Hassall, M.D., we read, to our amazement, that "Sanitas consists of a solution of substances (!) capable of furnishing considerable quantities of the most powerful of all *oxidisers, namely ozone!*" Thus, unless we misunderstand the somewhat obscure language of the testimonial, our old friend is risen again. Will no Œdipus tell the world plainly with which of the two, ozone or peroxide of hydrogen, we have here to deal? Of the latter compound, as present in the liquid, Dr. Hassall makes no mention.

In conclusion we may remark that if "Sanitas" fulfils even half the promises held out on its behoof, it has before it a triumphant future. An agent capable of fixing ammonia, of killing ferments, &c.,—and thus preserving wines, beer, and milk,—of destroying odours without injuring flavours, of bleaching glue and gelatine without affecting the colours of carpets, furniture, &c., of proving fatal to parasites, blight, and injurious insects without affecting vegetation, has not hitherto existed.

A Guide to the Determination of Rocks, being an Introduction to Lithology. By L. JANNETTAZ. Translated from the French, by G. W. PLYMPTON, Professor of Physical Science in the Polytechnic Institute, Brooklyn. New York: D. van Nostrand.

WE have here a work calculated to be of great service to the geological student by assisting him in the recognition of the various rock-species which he may encounter, and thus putting him in the position to observe for himself—the only manner in which geology can be usefully studied.

The author's introduction contains some valuable information as to the examination of laminæ of rocks by the aid of polarised light.

In the first part we find a description of the leading mineral species which constitute rocks, with their crystallographic forms, illustrated by diagrams; their behaviour before the blowpipe, and other characteristic reactions.

In the second part the author passes to a consideration of the rocks made up of the minerals above mentioned, with their normal and their accessory elements, and their modifications. Thus under Granite we are told that, in addition to its well-known normal ingredients—felspar, quartz, and mica—it may contain talc, chlorite, hornblende, tourmaline, cordierite, albite, epidote, pinite, graphite, emerald, topaz, zircon, garnet, &c. "Andalousite" is, in our opinion, an orthographical error, the English name of the mineral being "andalusite."

The third part of the work describes the method to be followed in the practical determination of rocks. Having found by inspection, and by reference to characteristics laid down in earlier parts of the book, whether the specimen under examination belongs to the globuliferous, the cellular, the schistose, the vitreous, &c., class, further examination is instituted. Thus in the globuliferous class the procedure is as follows:—

I. *With grains harder than steel.*
   - A. With vitreous globules } 1. Radiated texture.
   - B. With crystalline globules } 2. Splintery texture.
   - C. With irregular grains without intermediate matter.
   - D. Globules forming masses irregularly rounded.

II. *With grains softer than steel.*
   1. Effervescing in HCl. No magnetic bead on charcoal.
   2. Effervescing in HCl. Giving magnetic bead.
   3. Not effervescing in HCl. Giving magnetic bead.
   4. No effervescence, and no magnetic bead.

These tables are then further carried out, until the enquirer is conducted to the name of the species sought. Thus the class—1. Having a radiated texture, includes—

"In a vitreous paste, fusing to more or less hollow globules, white or grey (Spherulitic Obsidian).

"Globules in a matrix resembling a tissue of glass threads, cellular, fusible (Pumice with Spherulites).

"In a porous, subcrystalline, trachytic paste (Trachyte with Spherulites).

As an Appendix the author has added a "Dichotomic method for the Determination of Rocks," translated from

the "Cours Elementaire de Geologie Appliquée" of M. Stanislas Meunier.

The work may be decidedly recommended to students of geology.

Principles of Theoretical Chemistry, with special reference to the Constitution of Chemical Compounds. By IRA REMSEN, M.D., Ph.D., Professor of Chemistry in the John Hopkins University. London: Baillière, Tindall, and Cox. Philadelphia: H. C. Lea.

FROM the preface of this little work we extract the following passage:—"As for the value of the structural formulas which are discussed at some length in the second part of the book, it need only be said that if it be borne in mind what they are intended to represent, they are not quite so absurd as some chemists are just now trying to make us believe they are. These formulas certainly represent known facts in regard to the constitution of chemical compounds. They do not represent these compounds as a photograph, for example, represents a building, but rather somewhat in the same way that, in physics, lines represent forces in their magnitude and direction. Take the formulas for what they are and they have considerable value. Try to find in them the architectural plan of the chemical molecules and they appear absurd. But it is very unjust to find fault with a thing for not doing what it never pretended to do, and what its originators have distinctly stated it could not do."

This vindication of structural formulæ, which in substance we have often met with before, always reminds us of the apologies for image-worship offered by many good men, *e.g.*, among the Brahmins. "We don't," say they, "worship the wood or the stone, but merely use it to give a stimulus and a right direction to our devotions." The misfortune is that such nice distinctions, whether theological or chemical, are gradually but surely lost sight of. The eminent men who first introduced structural formulæ certainly never contended that they were thus giving a ground-plan of a molecule as it would appear if we were able to see and to distinguish the atoms of which it consisted. But is not the very word "splitting up" (*abspaltung*)—now so generally introduced as a synonym for decomposition—in itself a proof that their original limitation is being disregarded, and that the formula, instead of merely pointing out the directions of affinity between the elements of a compound, is rapidly coming to be regarded as something more? Without at all endorsing the views of Prof. Kolbe, who regards structural formulæ as a mere frivolous amusement (*spielerei*), we cannot help fearing that there is sometimes too free scope given to the imagination, and that assumptions are made whose demonstration might not be easy.

The first part of the work before us is devoted to a "general discussion of atoms and molecules." Of this the most interesting part is the section which treats of the properties of the elements as functions of their atomic weights. Under this head we find a very fair account of the "periodic law" of Mendelejeff, and of the classification of the elements founded thereon. Lothar Meyer's tabular arrangement of the elements (see *Annalen der Chemie und Pharmacie*, 7 suppl., 356) is also quoted, but the author does not enter upon an explanation of its principles. He very justly declares that an accurate determination of the atomic weights is a necessary preliminary before such speculations as those of Mendeleeff and Meyer can bear their legitimate fruit, or can even be capable of verification. We think, however, that the number of atomic weights which he gives as having been thus strictly ascertained is somewhat larger than is laid down on page 11.

On the question of atomicity or valence of the elements we find the author rejecting the idea of variable valence on the ground that it ascribes "to the atoms themselves creative power and the power to annihilate energy." At the same time, in his final conclusions, he lays down this proposition, that "valence is a fixed property of elements," which may be fully exerted or not." The distinction between this idea and the one just repudiated is scarcely as clear as might be desired. In the one case we have power variable, in the other power varying.

The second and larger portion of the book treats of the "Composition or Structure of Chemical Compounds," and contains views with which our readers are of course perfectly familiar.

CORRESPONDENCE.

ON THE MOTIONS OF CAMPHOR ON THE SURFACE OF WATER.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxxvi., p. 215, there is a communication from Mr. Tomlinson on the above subject. From it I have learned that in my paper (vol. xxxvi., p. 191) I have "adopted a theory that has more than once been abandoned," and that I "neglect the true theory," which is the theory of Mr. Tomlinson. My views, then, are not orthodox, according to the definitions which I believe we owe to Mr. Carlyle:—Orthodoxy is *my* doxy, heterodoxy is *your* doxy.

It really matters very little whether this is the case; the only thing of importance is whether the facts that I have published are facts, and whether they lead to the conclusions that I have adopted. The accuracy of the facts themselves can be easily ascertained by any one who will take the trouble, and no knowledge of chemistry is necessary for this purpose.

Let any one place a few small pieces of camphor on water held in a glass, and provide himself with a glass rod, a stick of sealing-wax, and a piece of flannel. To avoid misinterpretations the glass, sealing-wax, and flannel should be made as clean as possible, as otherwise we may open a door into the regions of contractile forces and surface tensions.

Let us suppose that the pieces of camphor remain at rest on the surface of the water. The operator may then rub his stick of sealing-wax and dip it in the water, when the pieces of camphor will immediately begin to gyrate. If this does not happen, the sealing-wax should be wiped dry, rubbed with flannel, and again dipped in the water, when the motions will begin. Under very unfavourable conditions it may happen that the motions will only begin after repeated immersions of the sealing-wax. If, now, the operator will take his glass rod and excite it with flannel he will, by dipping his rod in the water, succeed in arresting the motions. If, after the motions are arrested, he continues to use his glass rod, the motions will begin again, and these motions caused by glass may be arrested with the stick of sealing-wax.

Keeping in view these simple experiments, can anyone say that electricity is not responsible for these motions of camphor? If not, then by rubbing glass and shellac with flannel we do not produce electricity. Does it really matter whether one person or twenty persons have written that these motions are not due to electricity, and whether the idea that they are "has been more than once taken and abandoned?"

I have no wish to lower the importance of surface tension, of contractile forces, of "the effluvium that escapes from camphor explosively after the manner of fire-works," and of other explanations from respectable sources. In relation to all these, however, I would point out that if we must suppose that these are the causes of camphor motion, the consequence of the facts that I have cited is that surface tension, contractile forces, &c., can be made to vary at the will of the operator who has control of a glass rod, a stick of sealing-wax, and a piece of flannel,

and therefore surface tension, and the rest are only indications of the electrical condition of the water surface. Phenomena arising from greasy fingers, ear-wax, and other dirt may have importance of their own, but have no direct bearing on the clear issue before us.

As Mr. Tomlinson wishes me to reconsider my statement concerning evaporation, I have no objection in doing this if it is clearly pointed out to me, in a definite manner, wherein I am wrong. I have no desire, nor do I suppose that Mr. Tomlinson has, of adhering to ideas that are proved erroneous. What I said of evaporation was that while I was trying to find why camphor moved on the surface of water at times, and at other times did not, I tried to determine the motions by heating the water, but without success, while on some days the camphor moved on the surface of ice water. From this I was inevitably led to the conclusion that the difference of the quantity of camphor evaporated was not the cause of the camphor moving at certain times and not at others.

Electricity solved the problem, and I adopted electricity. We all know, however, that the rate of evaporation affects the electrical condition of the water surface; therefore evaporation must necessarily have some influence on these phenomena.—I am, &c.,

P. Casamajor.

Brooklyn, November 30, 1877.

DETECTION OF BISMUTH.

To the Editor of the Chemical News.

Sir,—Mr. Field's note on the detection of bismuth (Chem. News, xxxvi., 261), called forth by my remarks upon Von Kobell's test, draws attention again to the remarkably delicate process made known in 1862 by himself and Prof. Abel. Should there be any chemists who are still unacquainted with the reaction in question, they will have good reason to thank Mr. Field for again describing it in the Chemical News, as it is truly of most extraordinary delicacy. I did not allude to it when writing of Von Kobell's test and the suggested modification, not because I overlooked it, nor because I would for an instant suppose this latter to be as good, but, on the contrary, because I thought they did not come into any kind of comparison, and because their application is so totally different.

The blowpipe tests, even the very best of them, cannot, of course, compare at all with the "wet way," when really minute traces of metals are to be sought for. When I said of Von Kobell's test that it deserves to rank as one of the best—*in some cases* the best—test for bismuth, I meant that it very frequently renders any other and more elaborate process unnecessary. In less than a minute with cuprous iodide and aluminium plate, 0·1 per cent bismuth can be certainly detected in such substances as copper ores, regulus, &c., which do not contain too much lead or antimony using at most a decigramme of the powdered substance. In such cases I think the test may be spoken of as "the best," without in the least implying that there is none other more delicate when smaller amounts of bismuth are in question. Thus, 0·1 per cent is a perfect "heap" compared with the very minute amounts which can be detected by the method of Messrs. Abel and Field.

It is singular that neither the last edition of Fresenius (1874), nor of Rose (1867) contains any mention of this process, though I suppose they may be regarded as the completest and most authoritative works on qualitative analysis down to their respective dates.—I am, &c.,

W. M. Hutchings.

Laboratory, Wallasey Ore Works, Birkenhead, December 20, 1877.

New Battery with a Single Liquid.—T. Jourdain.—The electrodes are zinc and graphite, and the liquid is an aqueous solution of the mixture known as glass-gall.—*Comptes Rendus.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 23, December 3, 1877.

Artificial Production of Corundum, Ruby, and various Crystalline Silicates.—MM. E. Fremy and Feil.—The authors begin by forming a fusible aluminate and heating it to bright redness with a siliceous substance; the alumina is in this case slowly liberated from its saline combination in presence of a flux and crystallises. They attribute the crystallisation of the alumina to different causes, either to the reduction of this base by the gases of the furnace, or to the formation of a soluble silicate when the alumina is displaced by silica, or to a phenomenon of liquidation, which produces a very fusible silicate and sparingly fusible alumina. The displacement of alumina by silica seems the best method for effecting the crystallisation of the former earth. The authors place in a crucible of refractory earth a mixture of equal weights of alumina and red lead, and on calcining at bright redness for a sufficient time they find in the crucible, when cold, two distinct layers; the one is vitreous and consists of lead, the other is crystalline and often presents nodules filled with fine crystals of alumina. In this process the crucible acts by means of the silica which it contains. To avoid the loss of the product the authors generally use a double crucible. Colourless crystals of corundum are produced by the method just described, but the colour of the ruby may be obtained by adding from 2 to 3 parts of bichromate of potash, and that of the sapphire by using a small quantity of oxide of cobalt mixed with a trace of bichromate of potash. The crystals of ruby thus obtained are generally covered with silicate of lead, from which they have to be freed by prolonged heating in hydrogen and subsequent treatment with acids and alkalies. In certain cases crystals have been found almost pure and presenting all the characters of natural corundum and ruby. By the action of equal weights of silica and fluoride of aluminium kept at a red heat for several hours the authors obtain a silicate of alumina, agreeing in its composition and properties with dysthene, and on substituting boric acid for silica they produce a crystalline borate of alumina.

Report on a Memoir by M. Hautefeuille on the Reproduction of Albite and Orthose.—MM. Sainte Clair Deville, Des Cloizeaux, and Daubrée.—The process by which M. Hautefeuille has succeeded in the synthesis of albite and orthose consists in exposing the elements of these minerals, free or combined, to the action of melted tungstic acid or alkaline tungstates. Thus to form orthose a very basic silico-aluminate of potassa, containing 1 equivalent of alumina to 6 equivalents of silica was mixed with tungstic acid. If for potassa we substitute soda we obtain albite.

Law of the Absorption of Radiations across Bodies, and of its Application in Quantitative Spectral Analysis.—G. Govi.

Battery in which the Electrode Attacked is of Charcoal or Coke.—M. Jablochkoff.—The author fuses nitrate of potash or of soda and plunges into this, coke as attackable electrode, and as non-attackable, platinum or cast-iron. The latter electrode, made in the form of a pot, serves at the same time as a recipient for the melted nitre.

Action of Oxalic Acid upon Sodium Silicate; Hydrated Quartz.—E. Monier.—On pouring a weak solution of oxalic acid into silicate of soda in solution the two liquids do not mix, as there is immediately formed a siliceous layer of great resisting power, upon the upper

side of which crystals of oxalate of soda are formed. Upon prolonging the experiment the siliceous layer becomes thick and strong, and yields hydrated quartz harder than glass.

On Certain Properties of Boric Acid.—A. Ditte.—If melted and powdered boric acid is mixed with a small quantity of water,—say twice its weight,—the acid almost instantly increases in volume, becoming hydrated, whilst the temperature of the mixture rises to 100°. The crystalline acid in powder dissolves very rapidly in water with a fall of temperature; an equivalent of acid (62 grms.) at 15° absorbs 3187 calories in forming a solution almost saturated. If we add to the saturated solution half the quantity of water which it already contains, the fall of temperature on the dilution of the liquid is very slight, and corresponds to −241 calories per equivalent of acid dissolved. The specific heat of the hydrated acid is 0·353516. The specific gravity of the anhydrous acid is—

At 0°	1·8766
12°	1·8476
80°	1·6988.

Memoir on the Formation of Ultramarines, and their Colouration.—E. Guinot.—On following the successive phases of the furnacing of ultramarine, as generally prepared at present, we observe various colours, which succeed each other in the following order:—Brown, green, blue, violet, red, white. These colours are the result of the progressive oxidation of the original mixture of materials. When the furnace containing the crucibles reaches a red-heat the sulphur melts, and produces immediately polysulphides with the sodium. The compounds thus formed present various colours, but they are so unstable in presence of air and water that they cannot be defined. They appear to owe their colouration exclusively to the sulphides which saturate the mass. The first stable product is the brown; it appears at the moment when, as the fire gets hotter, blue flames issue from the crucibles, indicating that the sulphur is becoming converted into sulphurous acid. When the flames cease to appear this transformation is completed, and if the crucible is then withdrawn from the furnace it is found full of a green substance. When the heat reaches 700° the blue begins to form. If the heating is now continued, allowing the air still to enter in excess as before, the product takes a violet shade, then red, or rather rose, and becomes ultimately white. This white ultramarine, if mixed with a little charcoal and heated to redness, reproduces red, violet, blue, green, or brown, according to the proportion of charcoal added. By prolonging the heating, and consequently the oxidation, any one of these products derived from the white ultramarine may be made to pass anew through the scale of changes,—the brown, for instance, being successively converted into green, blue, rose, and white. If for charcoal we substitute hydrogen, sal-ammoniac, or other reducing agent, the same results are obtained. These facts seem to indicate that the progress of colouration follows that of oxidation. The proof of this is found on the examination of the products obtained at different stages of the heating. Sulphur produces the colouration because if some other member of its group be substituted the ultramarine changes its colour. The soda, if it does not directly produce the colouration, is still necessary, since if any other substance is substituted the colouration of the product is hindered. Finally, ultramarine is not a unique compound; there are a whole series of ultramarines, some coloured (sulphur, selenium, and tellurium ultramarines), others colourless (potassic, calcic, and lithic ultramarines), and the study of these bodies may possibly throw a new light upon the chemical composition of the pigment.

Modifications of Eggs, with Reference to a Memoir by MM. Béchamp and G. Eustache.—U. Gayon.—The author points out that some of the conclusions of MM. Béchamp and Eustache were anticipated in his inaugural dissertation in 1875. From some of their other views he dissents.

MISCELLANEOUS.

South London School of Pharmacy.—The Annual Dinner of this Institution was held at the "Horns" Assembly Rooms on Friday evening, December 21st; Dr. Muter in the chair. Dr. Julius Pollock presented the medals and certificates to the following successful competitors:—Senior Chemistry, Mr. Mortlock; Junior Chemistry, Mr. Heywood; Botany, Mr. Murdoch; Materia Medica, Mr. Hutton; Pharmacy, Mr. Mather.

MEETINGS FOR THE WEEK.

Tuesday, Jan. 1st, 1878.—Civil Engineers, 8.
Wednesday, 2nd.—Microscopical, 8.
Thursday, 3rd. London Institution, 7.
Friday, 4th.—Geologists' Association, 8.

Errata.—P. 261, col. 2, line 6 from bottom, *for* "although in the carbonates, atacamite, &c.," *read* "although in carbonates, atacamites, &c." P. 273, col. 1, *for* "Mr. John Mactear," *read* "Mr. James Mactear."

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